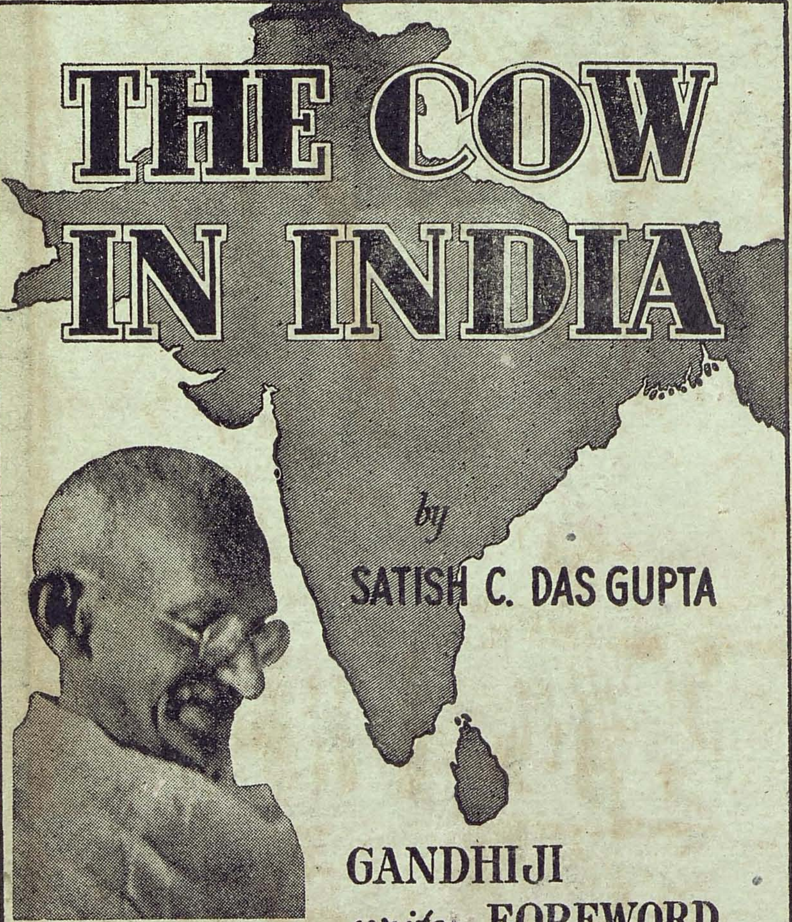
THE COW IN INDIA



by

SATISH C. DAS GUPTA

GANDHIJI *writes* FOREWORD

★ ★ ★ ★

I commend the volume to the lover of the cow as also to every one who would learn that the slaughter of cattle for food is a pure economic waste and know how he can turn the cow into a giver of plenty instead of being the giver of scanty which owing to criminal negligence she has become today.

★ ★ ★ ★

M K Gandhi

THE COW IN INDIA

IN TWO VOLUMES

Vol. II

THE BODY OF THE COW—ITS DISEASES AND TREATMENT

SATISH CHANDRA DAS GUPTA

KHADI PRATISTHAN,
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The Cow In India

PREFACE

In order to be able to attend to the cattle, suffering from diseases, and do something for them to alleviate their distress, it is necessary to know all about the organs of the animal and their normal working. This has been dealt with in **Part V** on **"The Body of the Cow."** Next, it is necessay to know all about the changes which the various diseases bring about in the system and the various organs. This science or the knowledge of the systems and organs in disease is called Pathology. Here, one gets familiar both with the diseases and the changes in the organs and diseased state. Next, comes the use of drugs for curing the disease. This is called Therapeutics.

But before the drugs can be handled, a knowledge of the drugs themselves and their action upon the organs is essential. These subjects are known as Materia Medica and Pharmacology.

Materia medica deals with the sources of drugs, their physical and chemical properties, their preparations and doses. Pharmacology treats of the actions of drugs upon living organisms.

After having acquired a knowledge of drugs and their uses, the veterinarian may then proceed to know all about the changes that diseases work out in the system or the Pathology, and then proceed to know about the use of drugs for treating the diseasese.

This volume (**Vol. II**) is accordingly divided into three parts :

Part V : The Body of the Cow.
Part VI : The Veterinary Remedies, Materia Medica and Pharmacology.
Part VII : Disease and their Treatment.

Part V.

The Body of the Cow, and the different systems have been dealt with in Part V. Inspite of the apparent difficulty of the lay reader which the names of different parts of the animal body present, and inspite of the very unattractive appearance of the sketches, showing the skeleton and the different organs, it will be found to be attractive once the ice is broken or the apathy for entertng into a technical subject is worn off. The various systems that are at work in the animal body are wonderful and romantic. They are amazing. The skeleton supporting the fleshy parts and various organs, the covering skin, the heart, the lung, the abdomen, the four compartmental stomach are all so wonderfully adjusuted to the requirement of the animal, that it becomes apparent that the internal machinery and the external parts were built, taking carefully into consideration the environments in which the animal was to function and to procreate.

Part VI

This part is devoted to Pharmacopœia and Pharmacology. The subjects have been very briefly treated. For, only a selected number of drugs have been taken. Ordinarily the Materia Medica includes hundreds of drugs and their actual number certainly exceeds a thousand. Few have the opportunity of trying all

those drugs and their various preparations. Yet, it is customary to include them. The veterinary Materia Medica follows the human Materia Medica and no separate official selection has been made for the veterinarian. For our purpose, a few drugs are taken into consideration and only these are described. The common village cow-*Vaidya* knows about the properties of various herbs and occasionally uses them to advantage. But these drugs require scientific examination and experimentation before they can be included in a book of this nature. It is for the various Veterinary Colleges and for the Central Research Institute to take up these; experiment with them, determine their compositon and efficiency and then recommend them to the public and the veterinarians for use. At this stage not much work has been done in this direction. We are, therfore, left with the very well-known herbs and drugs which are used for the diseases of men. A limited number of these only have been incorporated. The easily available and indigenous ones have been given preference.

Part VII.

Part VII deals with Pathology and Therapeutics. No separate division is made. In dealing with a disease its pathology is described first and then follows the treatment, class by class, the first ones being those belonging to the classes of the infectious diseases. The diseases affecting the various systems are taken up after that.

Fortunately the cow has a healthy normal life. Saved from contagion and infection, and given

nutritious food and shelter, the diseases are few. Most of these can be managed without great difficulty. For the infectious diseases immunity has to be acquired or induced ; vaccination, inoculation and serum injection are the means adopted. These fill the largest portion of the picture in dealing with them and with cattle diseases. Unlike the contagious ones the diseases of the different organs give time to deal with them and with the help of drugs and nursing much can be done to bring the animal back to health.

Some knowledge of **surgery** is needed to deal with the common cases and a Chapter has been devoted to it.

Difficult labour or **Dystokia** is a very important subject, and some elementary knowledge on it must be given. Practical experience has to be acquired, but a scientific grounding is necessary to develop the practical side of attending to labour cases to advantage. Therefore a Chapter has been devoted to Difficult Labour or **Dystokia.**

Finally, there are several things which could not be included in the short systematic treatment followed in the book. A Chapter on General Information has, therefore, been added, including a glossary of some technical terms. In this final Chapter some matter which had escaped systematic arrangement has been included which should have gone to make an addendum.

Khadi Pratisthan,
Sodepur, 18-8-'45. } SATISH CHANDRA DAS GUPTA.

THE COW IN INDIA

Vol. II

THE BODY OF THE COW—
ITS DISEASES AND TREATMENT

[IN THREE PARTS & TWENTY-EIGHT CHAPTERS]

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PART VI.

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THE COW IN INDIA

Vol. II.

PART—V

THE BODY OF THE COW

EXTERNAL PARTS OF THE COW

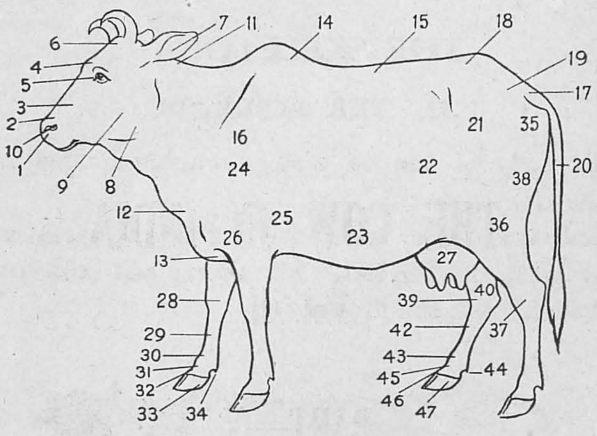


Fig. 1.

1. Lips or Muzzle ; 2. Nose ; 3. Face ; 4. Forehead ; 5. Eye & Eye brows ; 6. Forelock ; 7. Ear ; 8. Lower jaw ; 9. Cheek ; 10. Nostril ; 11. Pole ; 12. Dewlap ; 13. Chest or Breast ; 14. Wither ; 15. Back ; 16. Ribs ; 17. Root of tail ; 18. Loin ; 19. Croup or Rump ; 20. Tail ; 21. Hips ; 22. Flank ; 23. Belly ; 24. Shoulder ; 25. Elbow ; 26. Forearm ; 27. Udder ; 28. Knee ; 29. Cannon or Shank ; 30. Fetlock joint ; 31. Pastern ; 32. Coronet ; 33. Hoof ; 34. Fetlock ; 35. Haunch ; 36. Thigh ; 37. Stifle ; 38. Buttock ; 39. Gaskin ; 40. Hock ; 42. Cannon or Shank ; 43. Fetlock joint ; 44. Fetlock ; 45. Pastern ; 46. Coronet ; 47. Hoof.

CHAPTER XXXI

THE SKELETON

1242. THE SKELETON

The body of the ox may be roughly divided into the following parts :

Head and neck, back, the lumber and sacral and pelvic region, and the tail. The thorax and abdomen, the fore-limb and the hind-limb.

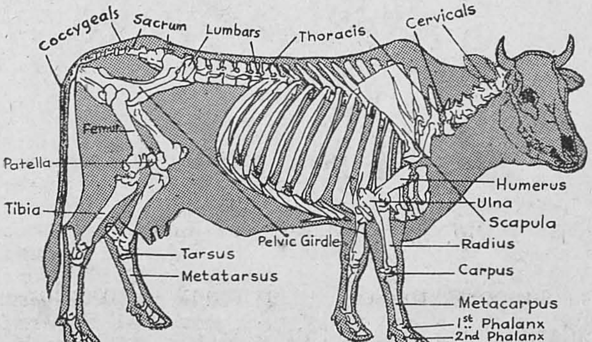


Fig. 2. The Cow : Regions of its body.

After the head comes the neck, and then the back. Continuing along the back comes the portion called loins or the lumber region ; then comes the sacral region which holds the pelvis below it. Beyond the sacral region is the tail.

Behind the neck and under the back are the thorax and abdomen. The thorax is the chamber holding the heart and the lungs. The abdomen is the chamber containing the digestive and excretory organs. Thorax and abdomen together is called the viscera.

In front of the thorax lie the fore-limb, and behind the loins lie the hind-limb.

All these parts are supported on a bony structure which is called the skeleton. The skeleton not only

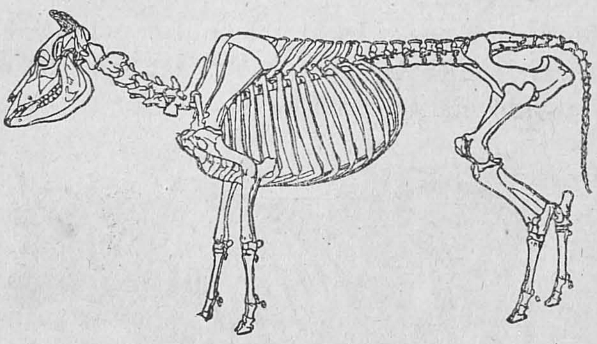


Fig. 3. Skeleton of the Cow.

gives support to the body but also allows the articulations or joints to function.

From the above figure, it will be seen how the bony structure of the skeleton supports the entire body, and gives shape to it.

From near the end of the head starts the vertebral column which is the main-stay of the entire body. The vertebral column consists of individual pieces of bone joined together by muscles and interposed

with pads in order to form a rigid chain which, however, permits of a certain amount of movement. The column supports the super-structure which itself is supported on the two pairs of front and hind limbs.

The portion from the head to the tail is called the axial part of skeleton and the four limbs are called appendicular part.

1243. THE AXIAL AND APPENDICULAR PART OF THE SKELETON

There are altogether 179 bones in the skeleton of the ox, distributed as under :

Head	...	10	
Face	...	20	
Vertebra	...	51	
Ribs	...	26	
Limbs	...	$18 \times 4 = 72$	including scapula and pelvis.
		Total—179	

1244. BONES OF THE SKULL

The skeletal frame of the head is called the skull. The skull is divided into the cranium and the face. The cranium is the portion which encloses the brain and its membranes. The face is placed in front of the cranium. The frame of the face is composed of a number of bones.

The names of the bones are largely the same as are used for the corresponding bones in human beings.

The cranium portion of the skull of the ox has the following bones :

Occipital	...	1
Parietal	...	2
Temporal	...	2
Inter-parietal	...	1
Frontal	...	2
Sphenoid	...	1
Ethmoid	...	1

Total—10 bones.

The horse has also the same 10 bones of the cranium. The human cranium is shown in Fig. 4, and its corresponding parts with its 8 bones are indicated.

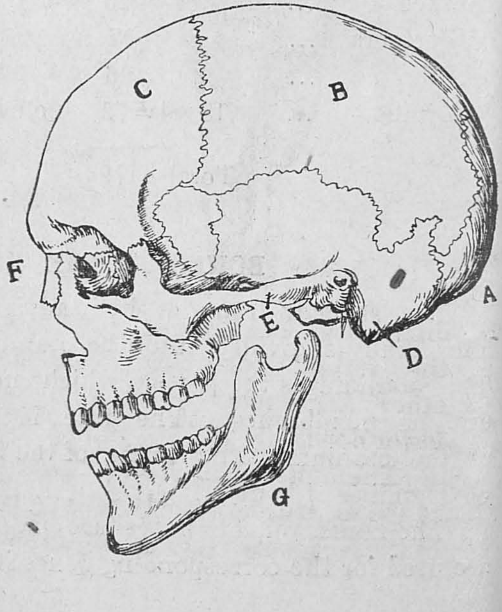


Fig. 4.
The human skull.

A. Occipital 1 ;
B. Parietal 2 ,
C. Frontal 1 ;
D. Temporal 2 ;
E. Sphenoid 1 ;
F. Ethmoid 1 ;

The construction of the human skull is remarkably different from that of the skull of the ox or of the horse in as much as a large number of bones of the human cranium can be felt from outside.

Next to the human skull, that of the horse allows several bones of the cranium to be seen and felt from outside. The skull of the ox is, however, shaped very

Fig. 5. The skull of the Horse.

1. Occipital ;
2. Parietal ;
3. Temporal ;
4. Interparietal ;
5. Frontal.

differently. It has to carry horns and, therefore, the frontal bones are exaggerated. Consequently, other important bones of the cranium are pushed lower down.

The front views of the skull of the horse and that of the ox are shown. It will be possible with the help of these figures (4, 5, 6, 7, 8, 9) to compare and study

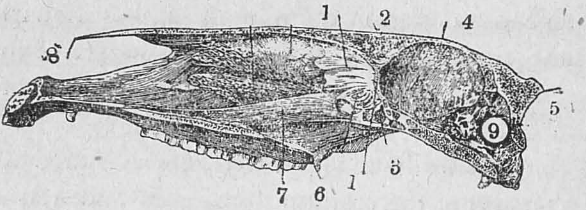


Fig. 6. Mesial section of skull of the Horse.
1. Ethmoid ; 2. Frontal ; 3. Sphenoid ; 4. Cerebral compartment of cranium ; 5. Occipital ; 6. Pterygoid ; 7. Vomer ; 8. Nasal ; 9. Cerebellar compartment.

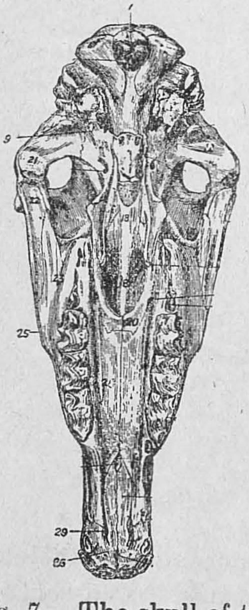


Fig. 7. The skull of the Horse (posterior view).
1. Occipital ; 9. Temporal ; 18. Vomer ; 20. Palatine ; 22. Malar ; 23. Superior Maxilla ; 25. Zygomatic Ridge of maxilla ; 26. Premaxilla ; 29. Incisor cleft.

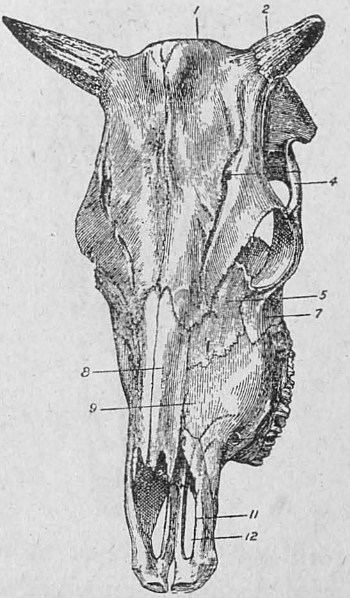


Fig. 8. The skull of the Ox (antero-lateral view).
1. Frontal ; 2. Horn core ; 4. Temporal ; 5. Lachrymal ; 7. Malar ; 8. Nasal ; 9. Superior maxilla ; 11. Premaxilla ; 12. Incisor cleft.

the difference between the skull of the ox and that of the horse, as compared with the human skull.

DESCRIPTION OF THE CRANIAL BONES

The **occipital** bone forms the back of the skull as also its under-surface where there is a large hole for the medulla oblongata to pass. The two **parietal** bones

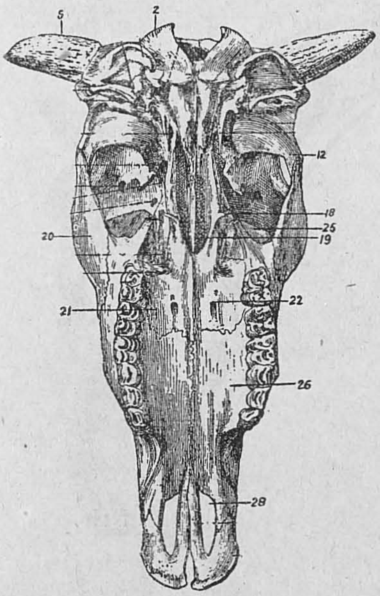


Fig. 9. The skull of the Ox (from behind).

2. Occipital ;
5. Horn-core ;
12. Temporal ;
18. Pterygoid ;
19. Vomer ;
20. Malar ;
21-22. Palatine ;
25. Lachrymal ;
26. Superior maxilla ;
28. Incisor cleft.

form the two sides of the cranium. In the ox no more than their anterior edges are visible when the skull is viewed directly from the front. Each of the parietal bone is bent nearly to a right angle so as to present an upper horizontal part which unites with the identical part of the opposite bone and a lower vertical part that descends into the depression of the temporal bone.

The horizontal part forms a flat plate which lies behind a line joining the bases of the horn cores of the frontal bones.

The two **temporal** bones form part of the lateral wall of the cranial cavity behind the parietal. There are two parts of each temporal, the squamous or the scaly and the petrous or stone-like. It is in this petrous or stone-like portion that the inner ear is situated.

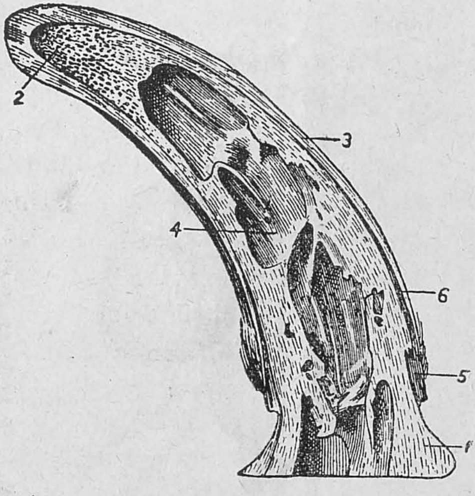


Fig. 10. Section of horn of the Ox.

1. Base of horn-core ; 2. Its tip ; 3. Cavity of horn-core ; 5. Skin ; 6. Soft texture between horn and core.

The **frontal** bones form the forehead. In man the frontal is a single bone while in the horse and in the ox there are two frontal bones joined together. The characteristic form of the skull of the ox is mainly due to the size and shape of this bone. It extends from the summit to a little below the middle of the anterior aspect of the skull, and the two bones together form the whole anterior boundary of the cranium. In most breeds of cattle these bones carry the horn core

or the flint which supports the horns. The length of the horns and the degree of curvature of the frontal bones vary with the breed of cattle.

The **inter-parietal** bone is peculiar to the ox and the horse. It is absent in the human skull. This bone is placed in the middle on the front of the cranium, being wedged in between the two parietal bones.

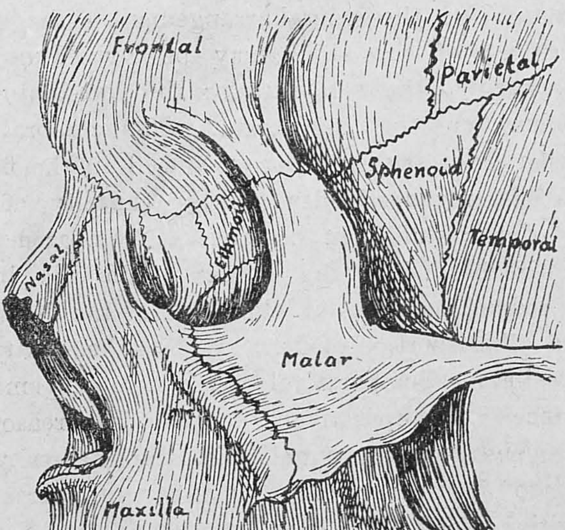


Fig. 11. Bones of the human skull and face.

Parietal, Frontal, Temporal, Sphenoid, Ethmoid bones of cranium.
Malar, Maxilla. Nasal bones of the face.

The **sphenoid** or wing bone is placed at the base of the skull. Its central portion underlies the base of the occipital bone. It connects the different bones of the skull.

The **ethmoid** or sieve-like bone is situated at the base of the nose. It has got many holes through which nerves enter the nose. It consists of 4 parts, a horizontal plate, a vertical plate, and two lateral masses. The two lateral masses in the skull of the ox are very large.

Fig. 6 shows the section of the skull of a horse through its middle. The skull of the ox differs from it in details, but the general arrangement is the same. The cavity of the skull may be divided into two compartments, the cerebrum or the fore-brain and cerebellum or the hind-brain. The cerebral and cerebellar compartments are 4 and 9 in the figure. From this a general idea of the capacity of the cavity of the skull can be had as compared with the entire head. In the human head the brain-case predominates, but in the head of the horse or the ox the portion taken up by the cavity of the brain is comparatively very much smaller. The face is comparatively large. The reason of the largeness of the mouth is the necessity of having to masticate a large quantity of coarse and innutritious food.

1245. BONES OF THE FACE

The human face is shorter than the face of the ox or the horse. The face of the horse is longer than the face of the ox. The human face has the following bones:

Nasal	...	...	2
Lachrymal	(Tear)	...	2
Malar	(Cheek)	...	2
Palate	...	...	2
Maxilla	(Upper jaw)	...	2
Mandible	(Lower jaw)	...	1
Vomer	(Plough share)	...	1
Inferior turbinated	(Scroll like)		2

Total—14 bones.

The face of the ox has the following 9 paired bones and two single bones, 20 in all.

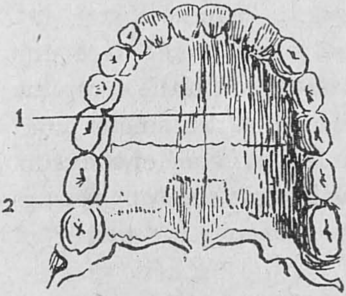


Fig. 12. The human palate bones.

1. Hard palate ; 2. Soft palate.

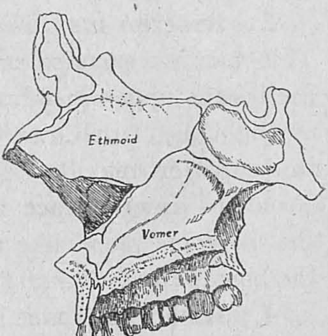


Fig. 13. Section through nose showing vomer of the human skull.

Paired bones : Pterygoid, Palatine, Superior-Maxilla, Lacrymal, Malar, Nasal, Premaxilla, Anterior turbinated, Posterior turbinated.

Single bones : Vomer, Inferior maxilla.

The paired bones :

1. **Pterygoid bone.** (Fig. 6—6 and Fig. 9—18). This is a small, slightly twisted, strap-like bone placed

at the side of the opening of the nose in the throat. Its outer surface is articulated to the vomer and the sphenoid. The upper extremity is pointed and is wedged in between the sphenoid and its root. This pair forms nearly the whole of the lateral boundary of the pharyngeal opening of the nose. The lower extremity is free and is like a pulley.

2. **Palatine bones.** (Fig. 7—20 and Fig. 9—21-22). This bone lie one on each side of the pharyngeal opening of the nose. This bone forms nearly a third of the hard palate.

3. **Superior maxilla.** (Fig. 7—23 and Fig. 8—9). This pair is situated on the sides of the face and carries the upper grinding teeth. With the exception of the bone of the lower jaw, which is a single bone, the superior maxilla is the largest bone of the skull. From the inner surface of the body of the bone springs the *palatine plate* like a shelf forming a large part of the bony palate.

4. **Lachrymal bone.** (Fig. 8—5). This bone is placed at the lower part of the orbit of the eye. The facial part of this bone is much larger than that of the horse.

5. **Malar bone** (cheek bone). (Fig. 7—22, Fig. 8—7 and Fig. 9—20). This bone is placed immediately behind the lachrymal. In the ox this bone has a more extensive facial surface than in the horse.

6. **Nasal bone.** (Fig. 6—8 and Fig. 8—8). The nasal bones are placed on the upper surface ofthe face, one on each side of the middle line. They

form the boundary of the nasal cavity in the front. Each bone has the form of a thin, slightly curved plate. In the ox these bones are both shorter and narrower than in the horse. They articulate with the frontal.

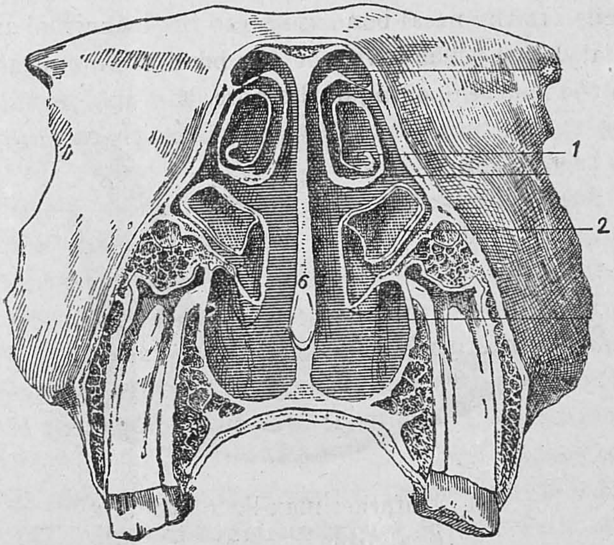


Fig. 14. Transverse section through the nasal chambers.

1. Anterior turbinated bone ; 2. Posterior turbinated ; 6. Septum of nose.

7. **Pre-maxilla.** (Fig. 8—11). These bones are placed at the lower part of the face. The body of this bone is thin and compressed from front to back. In the ox the upper incisor teeth is absent. This bone is also called the incisor bone.

8. **Anterior turbinated bone.** (Fig. 14—1). There are two bones, one on each side. On the whole, this bone appears to be conical. The inner surface is separated by the septum of the nose.

9. **Posterior turbinated bone.** (Fig. 14—2). It is very much larger than the anterior bones. It is attached to the nasal bone as also to the lachrymal and frontal bones. The cavity of the bone communicates with the middle opening of the nose.

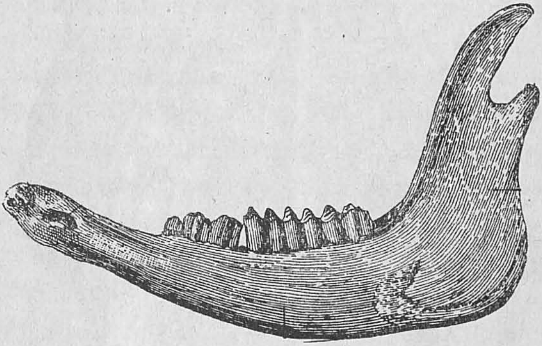


Fig. 15. Inferior maxilla of the Ox (mandible in man).

The above nine-paired bones are of the face. The two remaining single bones are the vomer and the inferior maxilla, making up the 20 bones.

The single bones :

1. **Vomer.** (Fig. 7—18 and Fig. 9—19. This bone is placed in the midline of the face forming a part of the partition between the right and left nasal chambers. It is like a slender plate lying within the depth of the opening of the nose leading to the throat.

It is articulated to the superior maxilla and is free beneath for a considerable distance.

2. **Inferior maxilla** or the lower jaw bone or mandible (Fig. 15) is the only movably articulated bone of the skull. The body of the bone carries eight close-set cavities for the grinding teeth.

1246. GENERAL ARRANGEMENT OF THE SKULL

The skull of the cow is made out of flat bones. The different bones are joined. None of these joints are movable. But these joints permit the growth of the bones after birth until the animal is adult. On reaching maturity, bony fusion occurs and the joints become obliterated. Many of the joints or 'sutures' are perceptible in the skull of a newly-born animal, particularly over the dome of the head.

In the cranium the **occipital** which lies at the back of the skull forms the back wall of the cavity of the brain, and through it passes the brain cord which emerges through the 'foramen magnum' or the opening for the spinal cord. To a rough prominence over the 'foramen' is attached a very powerful muscle which supports the head. On either side of this opening lie ball-like prominences which fit on to corresponding seats on the first vertebra or **atlas**. The lower part of the occipital runs forward along the base of the brain to meet the body of the **sphenoid** bone. Another name for the sphenoid is 'wing bone'. The sphenoid lies at the base of the brain and cannot be felt from outside on the head of a living animal.

It is shaped like a body with two pairs of wings. It is supposed to resemble a bird with two pairs of wings in flight trailing its leg behind. The body of the sphenoid is continuous with the base of the occipital, and helps to form the base of the brain.

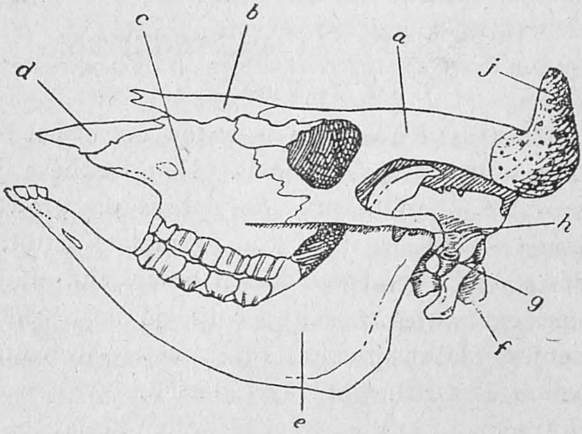


Fig. 16. Diagram showing arrangement of the Ox's skull.

a. frontal bone, which is continued outwards to form the horn core—j. spongy bone ; b. nasal bone ; c. maxilla ; d. incisive bone or pre-maxillary bone, carrying no incisor teeth ; e. mandible ; f. occipital ; g. petrous temporal bone ; h. mandibular joint.

The **ethmoid** lies between the back of the nasal passage and the brain cavity. It is, in fact, a 'sieve-like' partition between the nasal passage and the brain. Through the perforations of this bone pass the nerves of smell.

The **inter-parietal** bone lies between the two parietals. It has projections which serve to partially

separate the cerebral portion from the cerebellum or hind-brain.

The **parietal** bones form the sides. The **frontal** bones lie between the parietals behind and the nasal bones in front. The frontal bone forms the greater part of the expanse of the forehead. Each lends itself to making a part of the bony orbit in which the eye is lodged. From the frontal bones rise the horn cores.

The **temporal** bones lie at the base of each ear on either side. These bones have a petrous part which is dense, hard and stone-like. In these are excavated the tunnels for lodging the delicate structure of the sense of hearing. The other portion is a 'squamous' or scale-like part which forms part of the side wall of the cranium. The squamous part carries the surface with which the **mandible** is joined for articulating the lower jaw.

Of the face bones the **maxillæ** lie on either side of the face forming the greater part of the upper jaws. These touch almost all the bones of the face. They carry the teeth of the upper cheek. Inside, these bones have projections which are rigid plates. These form a good portion of the hard palate, the roof of the mouth and the floor of the nasal passage. Outside the maxilla is attached a part of the powerful masseter muscle which is of supreme importance in chewing.

The **incisor** bones lie in front of the maxillæ continuing them forward. **Palatine** bones form the posterior part of the hard palate and form the greater part of the boundary of the nostrils which is completed

by the thin strap of **pterygoid** bones. The **nasal** bones form the ridge of the nose. The two **lachrymal** bones are along the front edge of the orbit. The **turbinated** or scroll-like bones are covered with membranes which serve to warm and moisten the air in its way to the lungs. The **vomer** or plough-share bone lies below the nostrils separating the hind portion of the two nostrils from each other. **Mandible** forms the entire lower jaw and is the only movable part in the whole skull.

There is one other bone, the **hyoid** bone, which lies at the root of the tongue, supporting both the tongue and the larynx.

1247. THE VERTEBRAL COLUMN

The skull is attached through two prominences in the occipital bone to the first vertebra, the **atlas**. To

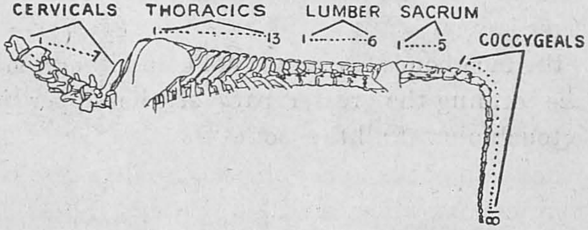


Fig. 17. The vertebræ of the Ox.

the first vertebra is attached the second one and to it the third one and so on in a chain-like structure forming the support of the neck which is called its cervical portion. The vertebra is continued to form the cervical or neck, and forms the **thoracic**, the **lumbar**, and the **sacral** portions on to the tail, forming

coccygeals or **caudal** part. The vertebral column thus extends from the neck to the tail. There is a definite number of bones in the vertebra of the ox from the cervical to the sacral portion and then in the tail or the coccygeal process. There are the following vertebral bones in the column :

1. Cervical ... ...7, forming the neck.
2. Dorsal or Thoracic...13, forming the back.
3. Lumbar ... ...6, forming the lumbar region.
4. Sacral ... ...5, forming the sacral or pelvic region.
5. Caudal or Coccygeal...18 to 20, forming the tail.

Total bones ...49 to 51.

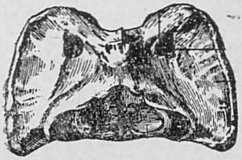


Fig. 18.
The atlas of the Ox.

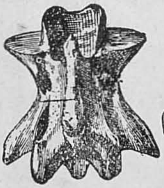


Fig. 19.
The axis of the Ox.

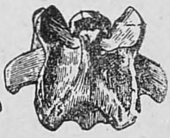


Fig. 20.
A cervical vertebra of the Ox.

Each has a solid part called the body which lies lowermost, and above this there is a ring through which the spinal cord passes. A disc is interposed between each of the vertebra which enables freedom of movement. The bore of the canal for the cord to pass is greatest in the **atlas** or the first vertebra. It is

very much smaller in the succeeding ones of the cervix. In the last three cervical and first two dorsal vertebra the bore again increases. Behind this they diminish up to the middle of the back. In the region of the loins the bore again increases, but at the last lumbar bone it rapidly diminishes, and at the end of the coccygeal bone it ceases to be a complete canal.

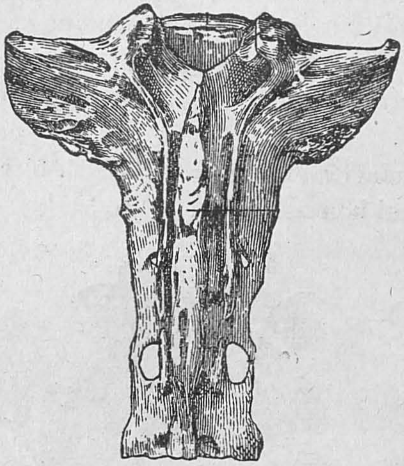


Fig. 21. The sacral bone of the Ox.

At the places where the bore is large, greater movement of the vertebra is possible without injuring the cord.

The tops of the vertebral bones have spine-like processes, some of which are large and some small. The cervical vertebræ or the bones of the neck have very short spines. The spines are very large

over the back after the neck and, as will be seen from the skeleton, they give shape to the withers of the horse or the ox.

1248. BONES OF THE THORAX

The vertebral column supports the ribs forming the thoracic cavity. The ribs have the vertebral

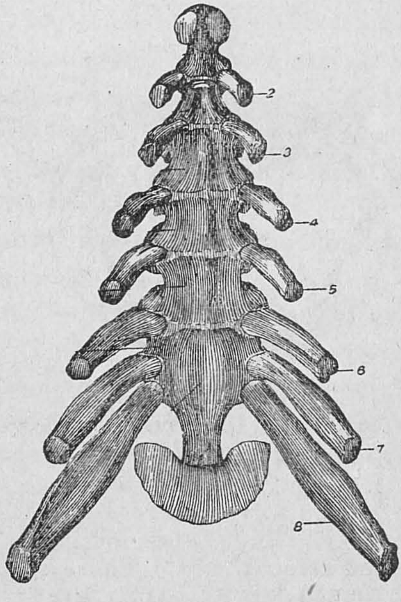


Fig. 22. The sternum of the Ox.
2—8 Ribs.

column at the upper end and the breast bone at the lower end. All the ribs, however, are not joined or articulated to the breast bone. The ribs are arranged in pairs on either side of the vertebræ. A pair

having the **vertebra** at the top and the **sternum** at the bottom forms a complete circle. There are 13 pairs of ribs in the ox and they form the thoracic cavity which has a conical shape and is compressed sidewise. The apex of the cone is at the neck. The ribs that are joined to the sternum are called sternal. Some ribs are not joined to the sternum, but each succeeding rib here is joined to the previous rib by costal cartilage.

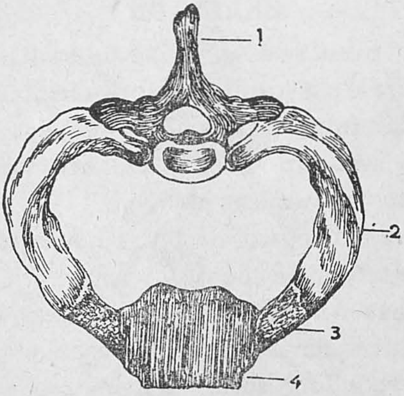


Fig. 23 The circle made by a pair of ribs.

1. Vertebra ; 2. Rib ; 3. Cartilage ; 4. Sternum.

These are called asternal ribs. There are eight pairs of sternal and five pairs of asternal ribs.

Each rib is elongated and curved and is a highly elastic bone. The first rib is the shortest and the least curved. The curvature of the ribs progressively increases from the first to the last. The ninth rib is the longest. Those that are in front of it and those that are behind are progressively shorter. In the

same way, the sixth rib is the broadest rib and those that are before and after are progressively narrower. The sternum or the breast bone of the ox is shaped like a flat-bottomed boat. In the ox and the horse there is no collar bone as in man. The first pair of ribs serves the purpose of the **clavicle** or collar bone.

1249. THE APPENDICULAR PART OF THE SKELETON

The two front and two hind-limbs together with the pelvic girdle constitute the appendicular part of the skeleton. The front limbs or the fore-legs correspond to the two arms in men, while the two hind-legs correspond to the two legs of men.

The general disposition of the bones of the limbs is approximately the same as in man with this broad difference that whereas there are fingers in men, in the ox or in the horse there are no fingers. But the bones corresponding to the fingers may be traced in the horse and ox. Even then where men have five fingers the ox only has two and the rudiments of another pair of digital bones unconnected with the skeleton.

1250. THE FORE LIMB

The fore-limb comprises the shoulder-blade or **scapula** of the ox, and five sections—the **arm**, the **fore-arm**, the **knee** or **carpus**, the **cannon** or **metacarpus**, and the **foot**. The scapula is a triangular plate of bone which allows of a large area for the attachment of muscles that bind it to the body.

From figures 24 and 25 are seen the respective positions of the scapula, humerus, radius, ulna, carpus, metacarpus and phalanges.

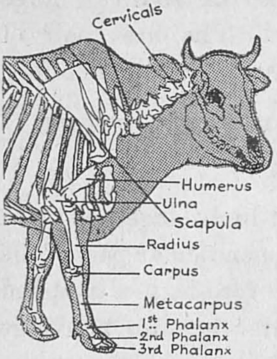


Fig. 24.
The fore limb of the Cow.

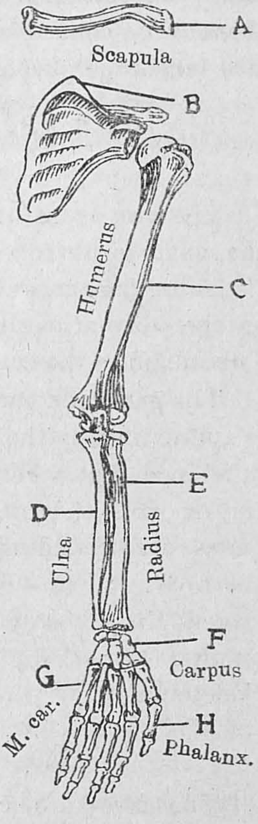


Fig. 25.
The human upper limb or the hand.

In man the joint of the humerus with the radius and the ulna is called the elbow joint. In the ox at this joint stands out the head of the ulna called **olecranon.**

The carpus is the wrist joint of man. Whereas the carpus of the ox looks like the knee and is called the

knee joint, although it is really the wrist. Then again, the metacarpus in man forms the palm of the hand and has 5 bones while the metacarpus of the ox looks like a straight bone or the shin having 2 bones fused together. Further on, in the human hand are the phalanges or finger bones. In the ox there also are the three similar bones of each finger, with this difference that while in man these form the finger, in the ox these form the fetlock and hoof. There are five fingers in man, in the ox these five are reduced to the two hoofs.

The **humerus** is the first bone of the fore-limb proper. Its upper extremity carries the head or ball which is received into the cavity of the scapula, forming a ball and socket-joint.

Its lower end is shaped somewhat like a broad pulley, and with the **radius** and the **ulna** completes the elbow joint. In man, the radius and ulna are two separate bones, where the radius gliding over the ulna permits of the rotation of the forearm on itself. In the ox the two bones are fused together. The ulna projects out at its outer end forming the **olecranon** or the point of the elbow. The radius bears the weight of the body. The lower end of the radius meets the **carpal** bones which are six in number, 4 in the upper row and 2 in the lower. This is called the 'knee' of the ox. This arrangement of the several small bones allows of flexion without sacrificing efficiency. The region of these bones is called the **cannon** region. This is really the wrist joint of the hand in man.

The carpal bones join on to two metacarpal bones which correspond to the bones of the palm in the human arm. In place of 5 metacarpal bones of the human upper limb, in the ox there are two carpal

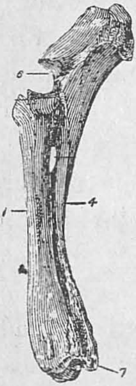


Fig. 26.

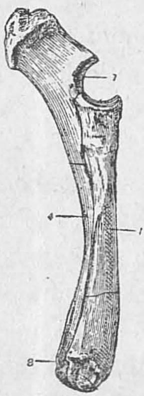


Fig. 27.

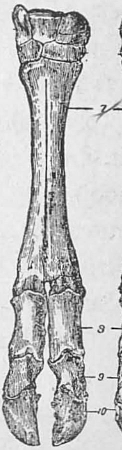


Fig. 28.

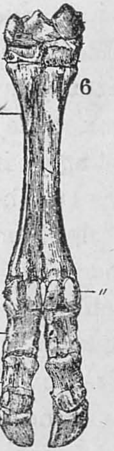


Fig. 29.

Fig. 26.—Radius and ulna of the Ox (outer aspect).

1. Shaft of radius ; 4. Shaft of ulna ; 6. Cavity for receiving the humerus ; 7. Lower end of the ulna.

Fig. 27.—Radius and ulna of the Ox (inner aspect).

7. Cavity for receiving the humerus ; 8. Lower end of Ulna.

Fig. 28.—The manus or the hand portion of the fore-limb of the Ox (front view).

7. The metacarpal ; 8. 9. and 10. The three phalanges.

Fig. 29.—Back view of the above.

6. The carpal ; 11. Sesamoid.

bones, the lower ends of which go to form the fetlock joint. The two metacarpal bones are fused together in the ox, except at the bottom where they are split.

Each of the split parts of the metacarpal meets the phalanx or the finger bones corresponding to it. There are 4 digits in the ox, corresponding to those of the human hand, minus the thumb. Of these,

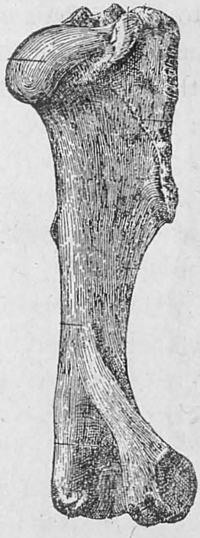


Fig. 30.
The humerus of the Horse.

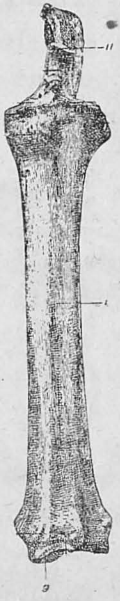


Fig. 31.
The radius & ulna of the Horse.
1. Shaft of radius ;
9. Lower articular surface ;
11. Olecranon.

Fig. 32.
The left manus of the Horse (viewed from behind).

only 2 are weight-bearing, the other two are very rudimentary and are placed behind the fetlock joint. The two weight-bearing digits are composed of three phalanges, the end ones being the claw of the ox.

Illustrations of the upper limb of man and the fore-limb of the ox and the horse (Fig. 24—29) will make the differences clear.

1251. THE PELVIS

As the fore-limbs are attached to the scapula or the shoulder bone, so the hind limbs are attached to the **pelvis**. Scapula is not united with the vertebra, but

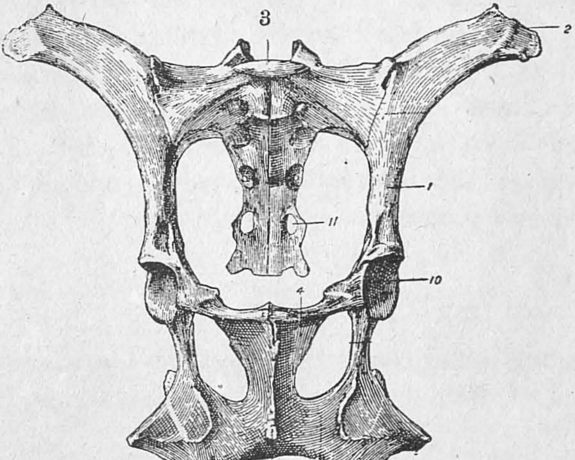


Fig. 33. Pelvis.

1. Shaft of ilium ; 2. Angle of the haunch ;
3. Top of first sacral bone ; 4. Pubic bone ;
10. Cavity for receiving femur or thigh bone ;
11. Sacrum.

the pelvis is. The pelvis is composed of two pieces of bones tightly joined together to form a basin-like structure, springing from the sacral vertebra. Each of the two bones of the pelvis are produced by the

fusion of 3 bones. In the cow it is through the opening of the pelvis that the calf emerges out at the time of delivery. The milking qualities of the cow depend considerably on the size of the pelvis. A large pelvis gives breadth to the hind quarters and allows ample room for the udder to expand.

There is a great deal of difference between the male and female pelvis, the latter being much broader and of greater capacity. The part of the pelvic girdle attached to the fused sacral vertebra is flattened and is more or less triangular. There is a cup-shaped cavity on each side of the pelvis for receiving the femur or thigh bone, to form the hip joint. The dimension of the inlet of the pelvic opening is $9\frac{1}{2}$ inches by 7 inches in a large-sized cow.

1252. THE HIND LIMB

The hind-limb possesses 5 sections like the fore-limb ; femur, tibia, fibula, tarsus, metatarsus, and the

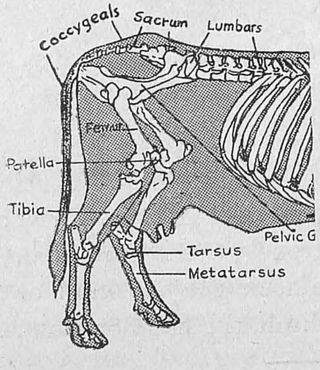


Fig. 34.
The hind limb of the cow showing pelvic girdle, femur, tibia, tarsus and metatarsus.

phalanges or the bones of the foot. The **femur** is like the humerus of the fore-limb, and the **tibia** and **fibula** correspond to the radius and ulna. Here the **tibia** is the larger bone. The upper end of the **tibia** lies below the cartilaginous discs of the stifle and gradually

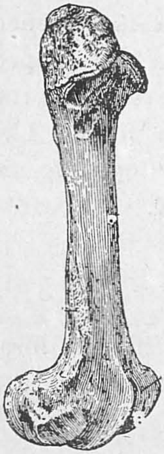


Fig. 35. Femur of the Ox.

Fig. 36. Tibia of the Ox.

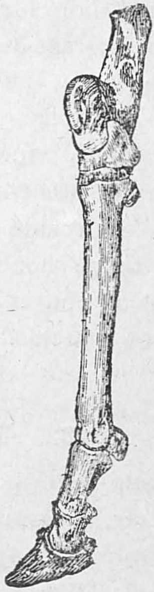


Fig. 37.

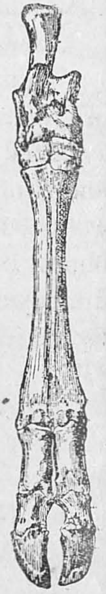


Fig. 38.

Foot of the Ox (side & front view).

tapers down to the next or hock-joint. **The fibula** is not developed. The bones of the **tarsus** or hock, corresponding to the carpus of the fore-limb, are five in number. Below the hock, the hind-limb or feet (*Pes*) is similar to the fore-limb, the hand or manus.

CHAPTER XXXII

THE MUSCLES AND JOINTS

1253. THE MUSCLES

Muscles are popularly known as flesh. They make up the tissue which by virtue of its power of contraction makes all movements possible in the higher animals.

The muscle is a tissue and the body may be said to be composed of tissues. The animal body begins with a single cell. Therefore, a cell is the smallest living unit. A collection of large number of cells is called a tissue. There are several kinds of tissues in the body :

1. Epithelial tissues or covering tissues.
2. Connective or binding tissues.
3. Muscular tissues.
4. Nervous tissues.
5. Blood and blood vessels.
5. Bony tissues.

The muscles are divided into two great classes—the **voluntary** and the **involuntary**. The muscle of the heart may be classed with the involuntary muscles, although there is some difference in the heart muscle from other involuntary muscles for which it may be classed by itself.

The voluntary muscles are also called striated, because under the microscope each muscle fibre shows very distinct cross stripping, while the involuntary muscles do not show these cross bindings.

Voluntary muscles form the chief clothing of the skeleton. It is the flesh or meat used as food by the carnivora. The muscles are made of very small fibres about $\frac{1}{500}$ inch long. Each fibre is enclosed in a sheath of its own. The fibres show nuclei. The sheath is attached to minute fibre-tissues which bind one muscular tissue with another.

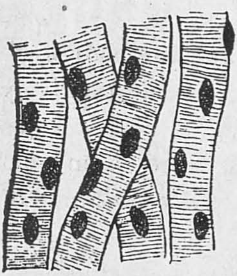


Fig. 39.
Fibres composing voluntary muscles.

The involuntary muscles compose the greater part of the hollow organs of the body such as the stomach and intestines, the arteries and veins, the uterus, the bladder, the urethra, the ducts, and the tunics. The fibres of these muscles are smaller than those of the voluntary ones. The involuntary muscle-fibre has pointed ends with an oval nucleus in the middle. The fibres are in bundles and adhere together with the help of a binding material.

The heart muscles are provided with projections which unite, forming a net-work.

The voluntary muscles or the flesh form one-third of the weight of the whole body of an average animal. Those muscles which cause the bending of joints are called **'flexors'**, and those that straighten the bent joint are called **'extensors'**. Those that carry the body away from the middle line are called **abductors**, those that rotate, making the limb prone or supine, are

Fig. 40.
Involuntary muscles from a teased-out portion of the wall of the small intestines.

Fig. 41.
Fibres of muscles of the heart.

called **pronators** or supinators. **Sphincter** muscles cause the contraction of a ring-like opening. They are involuntary, but some there are, that are voluntary. Some muscles end in **tendons** which are composed of very strong fibrous tissues and are attached to the bones.

There are many hundred muscles in the body of the ox. Only a few very commonly known muscles are described here.

1254. MUSCLES OF THE SHOULDER AND FORE LIMB

Trapezius : These muscles are connected with the scapula and make their movements possible.

Deltoid : This muscle abducts the humerus and rotate it upwards. It also flexes the shoulder.

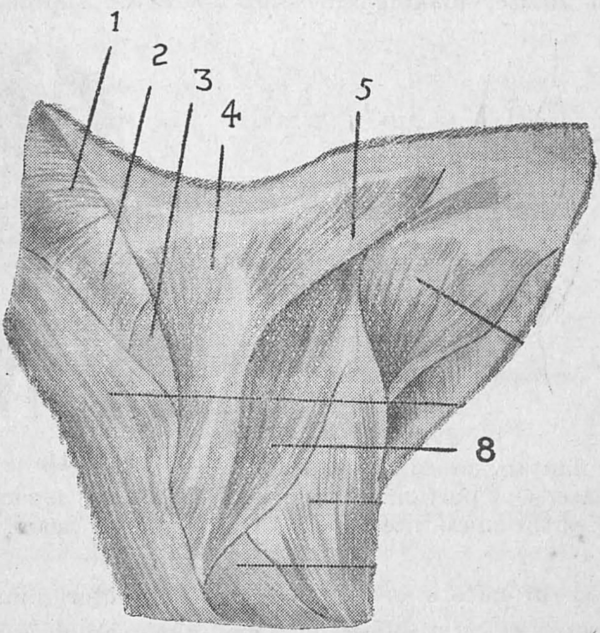


Fig. 42. Muscles of the shoulder.
(of the horse)

1. Splenius ; 2. Levator ang. scapulæ ; 3. Ant. deep pectoral ; 4. and 5. Trapezius ; 8. Deltoid.

Biceps : This muscle flexes the elbow joint and make tense the fascia of the forearm (fascia is fibrous membrane, covering a muscle or tissue).

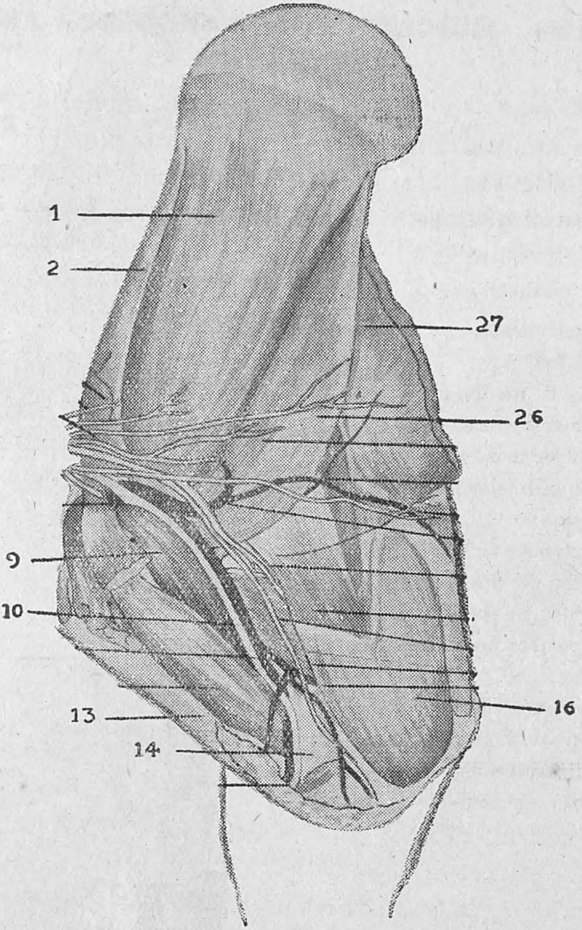


Fig. 43. Muscles of the shoulder and arm.
(of the horse)

1. Subscapularis ; 2. Supraspinatus ; 9. Post. deep pectoral ; 10. Median nerve ; 13. Mastoido-humeralis ; 14. Post. radial artery ; 16. Scapulo-ulnaris ; 26. Teres major ; 27. Latissimus dorsi.

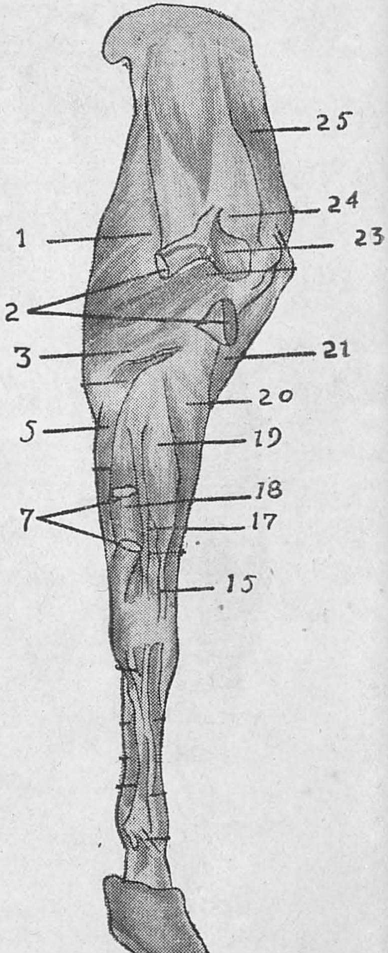


Fig. 44.
Muscles of the fore-limb.
(of the horse)

1. Caput magnum ;
2. Deltoid ;
3. Caput medium ;
5. Ulnaris accessorius ;
7. Flexor metacarpi ext.;
15. Extensor metacarpi obliq. ;
17. Extensor suffraginis ;
18. Deep flexors ;
19. Extensor pedis ;
20. Extensor metacarpi mag. ;
21. Biceps ;
23. Teres minor ;
24. Infraspinatus ;
25. Supraspinatus.

Supraspinatus : It is an extensor for the shoulder joint.

Infraspinatus : It abducts the humerus and rotates it outwards.

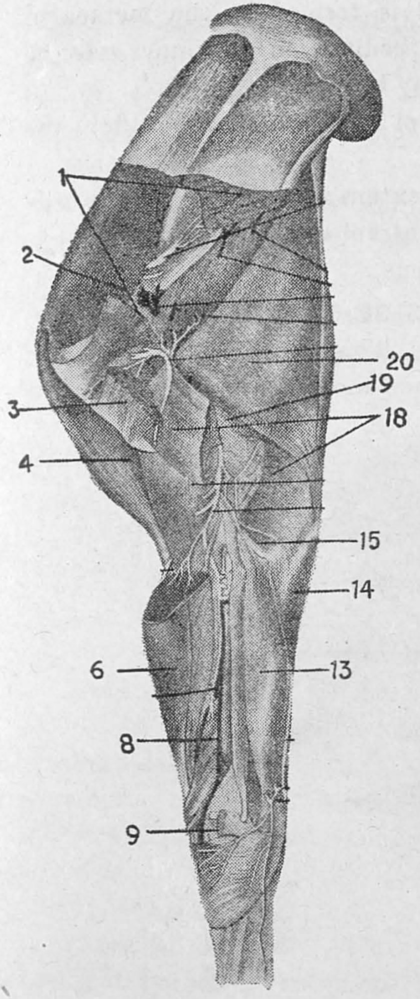


Fig. 45.
Muscles of the shoulder, arm and fore-arm.
(of the horse)

1. Infraspinatus ;
2. Supraspinatus ;
3. Deltoid ;
4. Biceps ;
6. Extensor metacarpi magnus ;
8. Extensor metacarpi obliquus ;
9. Extensor pedis ;
13. Flexor metacarpi ext. ;
14. Ulnaris accessorius ;
15. Anconeus ;
18. Caput medium ;
19. Caput parvum ;
20. Caput magnum.

Brachialis : It serves to flex the elbow joint.

Triceps : It lies opposite to the biceps and is an extensor of the elbow joint.

On the outer side of the front of the elbow joint,

a large muscular mass is formed by the **metacarpi magnus** and **extensor pedis.** On the inner side the tendon of the biceps may be felt.

The flexor metacarpi : These muscles flex the manus on the fore-arm.

Digital flexor and extensors : These successfully flex and extend the intraphalangeal joints, namely the fetlock and the carpus.

1255. MUSCLES OF THE HIND LIMB

The middle gluteus : This is a muscle of great size an [strength. It extends and abducts the hip. By its

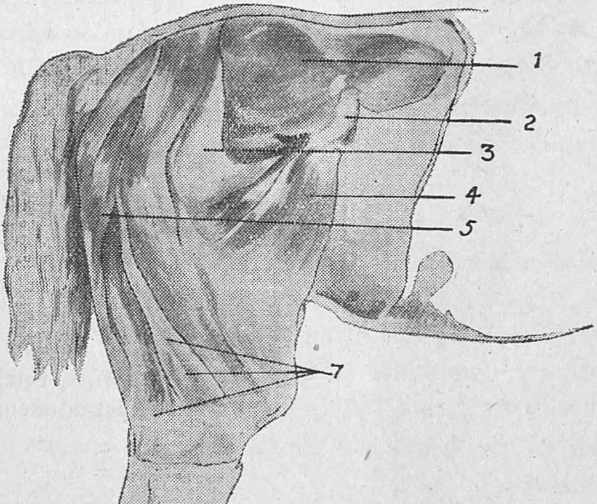


Fig. 46. Muscles of the hind-limb.
(of the horse)
1. Middle gluteus ; 2. Ext. angle of ilium ; 3. Superficial gluteus ; 4. Tensor vaginæ femoris ; 5. Semitendinosus ; 7. Biceps femoris.

action the femur and with it the whole limb is carried backward and forward, but when the femur is fixed the gluteal muscle raises the trunk bringing the animal to a rampant position.

Biceps femoris : This is one of the largest muscles. It arises from the sacral spine and is attached partly to the patella. It is partly inserted in the femur. On account of its being attached to the patella it works as an extensor of the stifle and an abductor of the hip. Part of it works as an abductor and outward rotator at the stifle.

Gastrocnemius : It has got two fleshy heads terminating in a single tendon. The tendon of gastrocnemius corresponds to the firm tendon extending upwards from the human heel and known as the tendon of Achillis.

1256. MUSCLES OF THE FACE

Masseter : This muscle covers the lower jaw. It is a flat semi-circular muscle and is thick and powerful. It rises from the malar and superior maxilliary bones and is fixed on the lower jaw. It elevates the lower jaw and aids in mastication by bringing the lower teeth forcibly in contact with the upper.

Ligament Nuchæ : This is the largest ligament in the body. It is placed on the middle plane of the neck above the vertebræ and on either side of it. It assists in suspending the head, and when the head is depressed it aids the muscles in elevating it again.

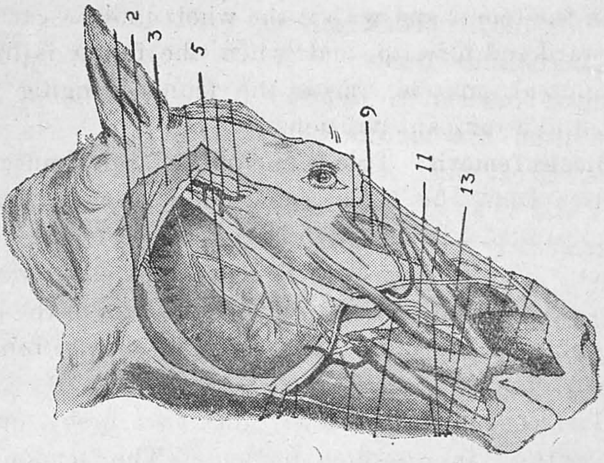


Fig. 47. Muscles of the face.
(of the horse)
2. Maxillo-muscular vessels ; 3. Parotid gland ;
5. Masseter ; 9. Levator labii sup. proprius ;
11. Zygomaticus. 13. Buccinator.

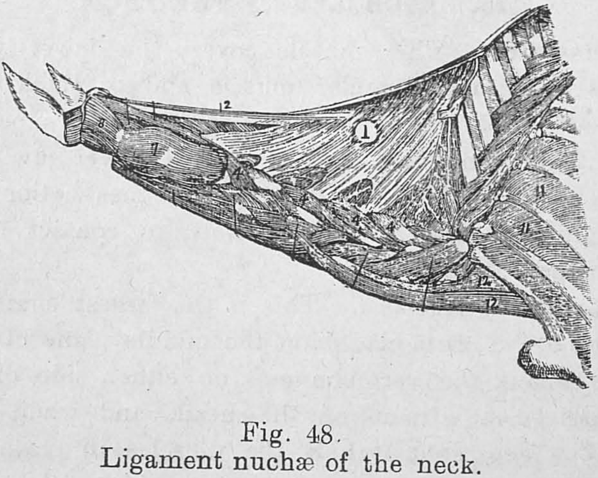


Fig. 48.
Ligament nuchæ of the neck.
1. and 2. Ligament Nuchæ.

1257. MUSCLES OF THE BACK

Longissimus Dorsi : This is the longest and strongest muscle in the body. It extends along the spine from the sacrum to the neck. In the loins it forms a great mass of muscle and tendon.

It acts as an extensor of the dorso-lumbar portion of the spine.

1258. THE JOINTS AND LIGAMENTS

A joint is also called an articulation. It is formed by the union of two or more bones or cartilages.

Fig. 49.
The left stifle joint showing the bands of ligaments.

Generally two bones are joined, but sometimes cartilages also form partners in joints. Joints are either movable or fixed. The fixed joints make the jointed bones behave as one piece, such as the bones of the skull.

Where two bones join to form a movable or articulated joint, there is a layer of cartilage on the contact-surfaces, and the two bones are held together by ligaments. Ligaments are strong bands of fibrous tissues which bind together the bones. They are cord-like or sometimes tape-like.

At the joints there are closed bladders of membrane which are called **synovial membrane** secreting a fluid called the synovial fluid which helps to lubricate a joint. Over and above these are the muscles which by their extensor or flexor action help to move the jointed juices.

Varieties of joint : (1) Gliding joint, (2) hinge-joint and (3) ball and socket joint are the common varieties. In the gliding joint the bones have flat surfaces capable only of a limited amount of movement. The vertebræ, the bones of carpus and tarsus, have gliding joints.

In the hinge-joint the bones move about on axis like the flap of a door. The parts jointed by the hinge-joint bend and open out as at the elbow, fetlock and pastern.

In the ball and socket joints one end of a bone is rounded like a ball and is inserted into the cavity of the other bone. The shoulder joint of scapula with humerus, the hip joint of pelvis with femur, are examples of ball and socket joint.

CHAPTER XXXIII

THE ORGANS OF THE OX

1259. THE ORGANS

The skeleton provides the bony structure over which the muscles are attached for covering and articulation and to let the body perform the various movements, part by part and as a whole.

Within the frame-work of the skeleton and covering it are the various organs. The head and neck have their different organs. Then comes the great cavity of the chest and abdomen. Beginning with the apex of the cage of ribs near the neck and shoulder and ending with the pelvis, there is a large cavity filled with organs. This cavity is primarily divided into two parts by a screen of muscle—the diaphragm. The diaphragm is between the chest and the abdomen and is a complete screen separating the compartment of the chest from the compartment of the abdomen.

1260. THE ORGANS OF THE CHEST OR THORAX

The **chest** contains principally the organs of the lungs and heart, while in the other compartment of the abdomen are situated the various organs of digestion and also some excretory and other organs. We shall consider the organs of the thorax or chest first.

The **chest** is that compartment of the cavity which is placed nearest to the neck. It is like a cage formed by ribs. The two sets of ribs are on two sides. On the top they emerge from the thoracic vertebræ, and below join with the sternum or the breast bone. The base is formed by the diaphragm. The apex of the cavity protrudes into the neck.

Between the ribs lie the inter-costal muscles which are in two layers, one almost at right angles to the

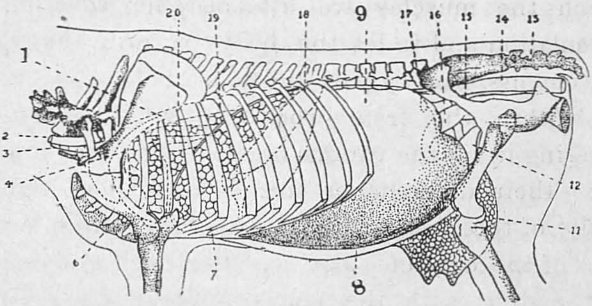


Fig. 50. Internal organs of the Cow.

1. Aorta; 2. Œsophagus; 3. Trachea; 4. Pulmonary artery; 6. Heart; 7. Reticulum; 8. & 9. Rumen; 11. Udder; 12. Urinary bladder; 13. Vagina; 14. Rectum; 15. Ureter; 16. Uterus; 17. Left ovary; 18. Spleen; 20. Posterior vena cava.

other. The whole of the outside is covered with large and small muscles, the larger ones being at the shoulder. The shoulder blades or the scapula lie outside and over the ribs.

The chest contains the two **lungs** one on either side. Two tubes, the **trachea** and **bronchus** enter the lungs.

Between the lungs and projecting more towards the left lies the **heart**. Various arteries and nerves

and the **œsophagus** or the pipe for food materials pass through the chest on to the other side of the diaphragm. Each lung is covered by a membrane called pleura. The heart is enclosed in a special sac called **pericardium**.

The lungs are organs for breathing. By inspiration air goes into the lungs, comes in contact with blood

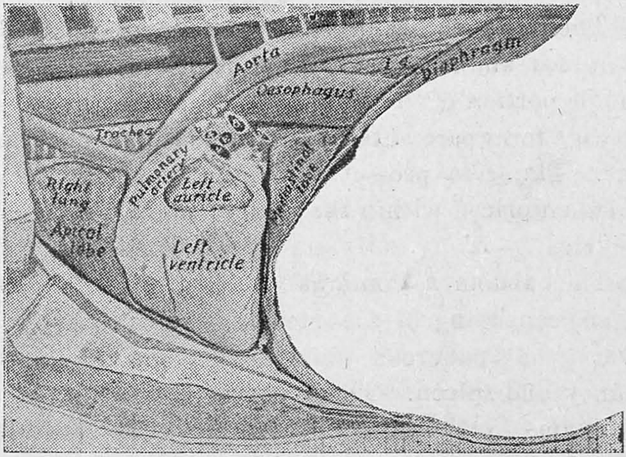


Fig. 51. Diagram of the chest containing the heart and lungs, and also showing the aorta, œsophagus, trachea and diaphragm.

which the heart sends to it for purification. The purified blood goes back to the heart and the impurities are taken up by air which goes out through expiration.

The system which circulates blood throughout the body is called the circulatory system, and the heart is its central organ. The system that purifies blood by contact with air, through the process of inspiration

and expiration, is called the respiratory system. The lungs are its central organs. The chest, therefore, encloses the central organs of the circulatory and respiratory systems, the heart and the lungs. Fig. 51 shows the relative position of the heart and lungs and the several organs.

1261. THE ORGANS OF THE ABDOMEN

The abdomen lies between the thorax which is in front of it and the pelvis which is behind it. It is the middle portion of the trunk. The diaphragm and the rib cage form part of the wall of the abdomen on either side. The ribs protect some of the organs of the abdomen placed within the space under the cage of the ribs.

The abdomen contains principally the digestive organs consisting of the **stomach**, the **intestines**, the **liver**, the **pancreas** and the associated organs of **kidney** and **spleen.** These organs of digestion of the ruminants are different from the organs of other animals. The ruminants of which the ox is one possess four stomachs, while animals like the horse have only one stomach. This makes a large difference in the disposition of the organs within the abdomen. The four stomachs of the ox are the **rumen**, the **reticulum**, the **omasum** and the **abomasum**. The first stomach or the rumen occupies the whole of the left side of the abdomen from the diaphragm to the pelvis and encroaches on the right side of the body to a certain extent. The spleen lies on its outer and upper surface. With the exception of this there are no other organs

to the left. It may be said that **the spleen** is the only other organ placed on the left side of the abdomen. The left kidney and the part of the second stomach or the reticulum are also placed on the left side, but it is pushed over to the right side if the rumen becomes full. The second stomach lies low down in front of the rumen between it and the neck. The globe-shaped third stomach or **omasum** lies on the right side about opposite to the 7th and the 11th ribs. The 4th stomach or **abomasum** is an elongated sac lying on the right lower wall of the abdomen. It opens into the **duodenum** from where commences the small intestines, which is a tube 130 feet long. The small intestine of man is only 21 feet. The intestines terminate in a pear-shaped portion of it called the **cæcum** from where the large intestine commences. The cæcum lies on the right side of the abdomen and partly in the pelvis. From the cæcum the colon passes in a double spiral, some coils going towards the centre, other coils passing out from the centre. The greater portion of the **colon** is on the right side, half way between the spinal column and the bottom of the abdomen. The liver lies on the right side against the diaphragm and in between the reticulum and the omasum. The liver has a gall bladder. Herein the ox differs from the horse which has no **gall bladder**.

The **pancreas** lies between the duodenum and the liver, close to the diaphragm.

Of the two **kidneys** the right one is situated below the last rib. The left kidney is peculiar in as much

as it has to move away according to circumstances. When the **rumen** is not quite full the left kidney remains on the left side. But when the rumen becomes full of food materials, the left kidney is

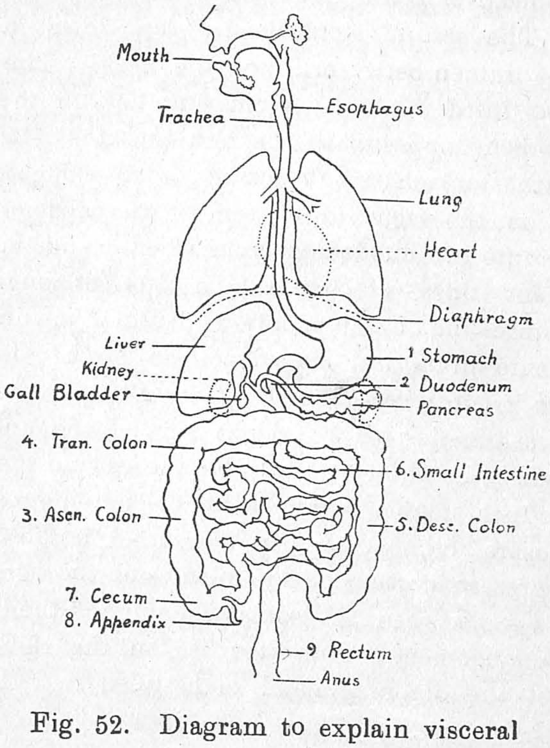


Fig. 52. Diagram to explain visceral organs of human beings.

The respiratory and circulatory organs above the diaphragm. The abdominal organs below diaphragm.

pushed out of the left side to the right side of the middle line, behind and below the right kidney. The kidneys have lobes. The **spleen** is placed

between the left upper part of the rumen and the left abdominal wall.

The food materials enter from the mouth into the œsophagus. Alongside the œsophagus lies the **trachea** or wind pipe. In order to ensure that no food material may pass into the wind pipe, a flap of cartilage called **epiglottis** operates to shut down the opening of the trachea when the food tries to enter it.

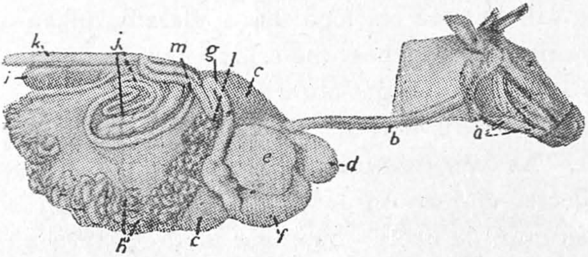


Fig. 53.

Diagram to show the digestive tract of the Cow.

a. Salivary glands ; b. Gullet ; c. Paunch, or first stomach (only a small part of the paunch is here visible, the rear portion being hidden by the intestines) ; d. Honey comb, or second stomach ; e. Manyplies or third stomach ; f. Fourth or true stomach ; g. Duodenum, or first part of small intestine ; h. Mesenteric part of small intestine ; i. Cæcum ; j. Colon ; k. Rectum ; l. Point of entrance of bile duct into duodenum ; m. Point of entrance of pancreatic duct into duodenum.

The swallowed food passes down to the rumen, and can be pushed out into the mouth for more chewing and making the morsel fit for digestion in the stomach.

The food travels after rumination to the reticulum and then to the third stomach or omasum and finally

to the real or the fourth stomach or the abomasum. From the abomasum starts the **duodenum** or the delivery end of the stomach. Near the duodenum the food receives bile from the liver and pancreatic juice from the pancreas which help the digestion of the ingested stuff. Then the food travels the 130 feet of intestines undergoing changes all the time. The food material then reaches the cæcum which is the junction of the small with the large intestine. All chemical and biological changes in food have already taken place by the time it reaches the cæcum, and most of the absorbable food has got absorbed. The large intestine absorbs what is left of the useful material and also water. As digestion proceeds the absorbable material is collected and discharged into the portal vein to be carried into the liver. The liver is a great workshop in the stomach, one of the functions of which is to store the soluble sugar material in an insoluble form or **glycogen**. When there is shortage of food or sugar in blood the stored material from the liver—'glycogen'—gets dissolved and then goes to mix with the blood. The liver also separates some of the non-absorbable excretal matter from the blood and sends them back to the kidneys.

Bile is manufactured in the liver out of the materials supplied by blood from the portal vein. It accumulates in a sac called the gall bladder. The bladder injects bile into the food as it reaches the duodenum. In the kidneys the extra water of blood and the soluble impurities in it are separated. This latter substance is called urea. After separation from

blood, the extra water and the excretal poisonous matters are sent through the conduit pipes called ureters to the bladder which is the vessel for receiving urine.

The spleen is another organ which takes up the spent-up blood corpuscles from the blood and sends them to the liver for conversion into bile there.

1262. THE ORGANS OF THE HEAD.

The brain, ear, eye, nose and mouth are the organs of the head.

1263. THE BRAIN.

The **brain** is situated in the casing of the skull. It is divided into two parts, the fore brain or **cerebrum**

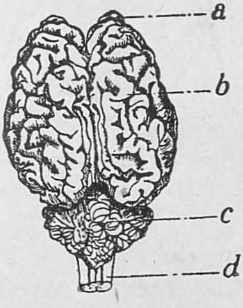


Fig. 54.
Upper aspect of the brain.
a. Olfactory bulb ;
b. Cerebral hemispheres ;
c. Cerebellum ;
d. Medulla oblongata.

and the hind brain or the **cerebellum**. The **medulla oblongata** is connected with both the brains. The cerebrum is the largest portion of the brain. The brain matter ends in the medulla oblongata which passes out of the skull through the **foramen magnum** and is continued through the tube-like opening formed by the vertebræ. If there is any injury to any part of the brain matter, the corresponding function to

which that part of the brain is the seat ceases to be operative.

1264. THE EAR.

The **ear** is situated in very hard and finely-carved cavities in the **temporal** bones. A **canal** of bone passes from the outer ear to some depth where the passage is blocked by a thin wall of membrane called

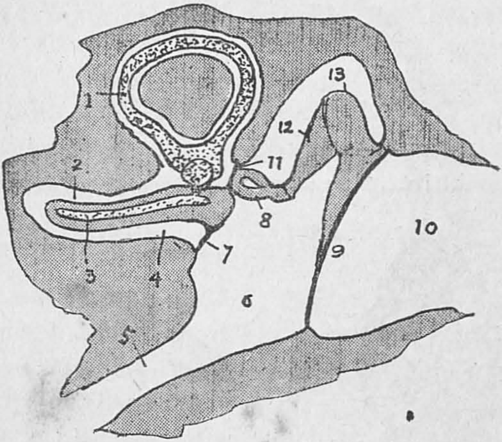


Fig. 55. The ear.
6. Middle ear ; 9. Drum ; 10. Canal of the external ear.

the **drum.** Up to the drum is the **outer ear.** Then the canal is continued some distance and there is another membrane. This portion is the **middle ear.** After this, in the bony cavity, are lodged very delicate instruments for detecting sound and for transmitting the impression to the nerve ends which are placed there. This portion is called the **internal ear** which has a labyrinth.

1265. THE EYE.

The eye is a ball placed in a socket of bone or the **orbit.** It may be regarded as an window or opening for receiving light and communicating the light-impressions to the brain.

The outermost portion is the **cornea.** It is transparent. (Fig. 56) The space behind it is filled with a

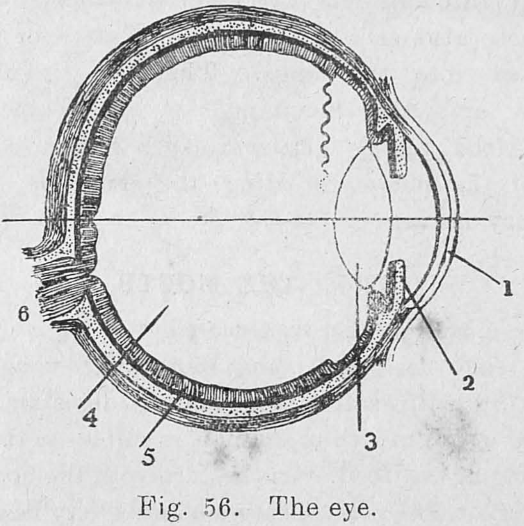


Fig. 56. The eye.

1. Cornea ; 2. Iris ; 3. Lens ; 4. Vitreous humour ; 5. Retina ; 6. Optic nerve.

transparent watery fluid. After the cornea comes a coloured curtain with a hole in the middle called **iris** which is capable of becoming larger or smaller and thus of accomodating more or less light inside. The hole is called the **pupil.** Behind this is the **lens.** Behind the lens is a large space filled with a thick transparent fluid called **vitreous humour** lying in front

of the screen for receiving light-impressions, or the **retina**. Behind the retina the nerve-ends, making the retina, collect to form a cord or the **optic nerve** which passes to the brain.

1266. THE NOSE.

The nose is the passage for air intake to the lungs and for throwing off the foul air from the lungs. The nose also serves as the pre-heater for the air admitted into the lungs. There are many blood vessels and the incoming air in contact with these blood vessels gets warmed. The nose is the seat of the nerves creating the sense of smell or **olfactory nerve.**

1267. THE MOUTH.

The mouth is the first recipient of food. Food is made ready for swallowing here by chewing and by admixture with **saliva** for helping digestion. The opening of the mouth in animals is suited to the needs of managing the food. In the carnivora the opening is very large. The jaws open wide and a very large piece can be held between the teeth in the mouth. The lips are also suited to the food. In the horse the lips are large and are capable of much movement. In the ox the lips are shorter. The upper boundary of the mouth is the palate and the floor is made up of the tongue and its accessories. The side-walls are formed by the cheek. The teeth are set in a projection. The mouth is lined with mucous membrane, and has an inlet for air from behind the palate, connecting

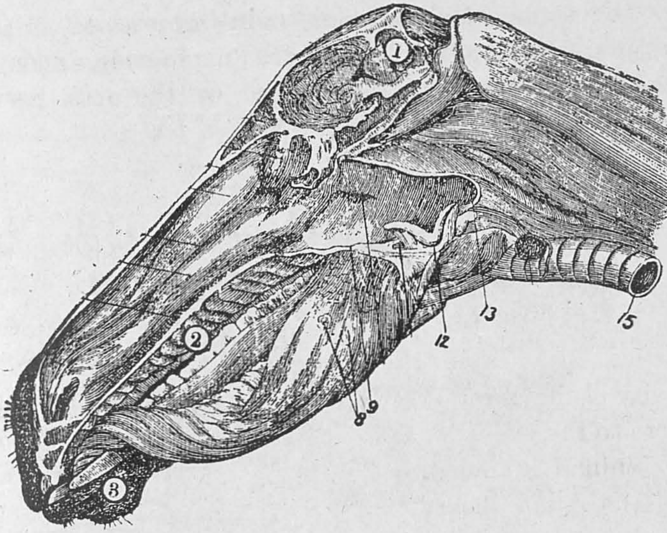


Fig. 57.

Section of head of the horse showing the mouth.

1. Cranium ; 2. Teeth ; 3. Lip ; 8. Tongue (displaced) ;
9. Soft palate ; 12. Larynx ; 13. Œsophagus.
15. Trachea.

it with the nose. The air passage passes through the **trachea** and food passes through the **œsophagus**, both of which are placed in the throat.

CHAPTER XXXIV

THE WORKING ORGANS OF THE OX

1268. THE CIRCULATORY SYSTEM.

The **heart** is the central organ of the circulatory system. It lies in the lower and front part of the cavity of the chest, between the lungs, but projecting more to the left side than to the right side. When an animal stands quietly with its two fore-feet together, the heart lies between its two elbows. A line joining the points of the elbows will pass through the apex of the heart. Its base lies opposite, from the 3rd to the 6th rib, (Fig. 58) and its apex lies above the last segment of the sternum. It lies in close contact with the diaphragm, when the chest chamber shrinks due to expiration. During inspiration, when the diaphragm recedes, it moves off from the apex of the heart.

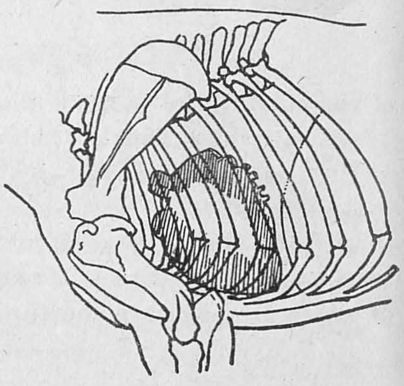


Fig. 58. The heart in relation to the bones of the chest.

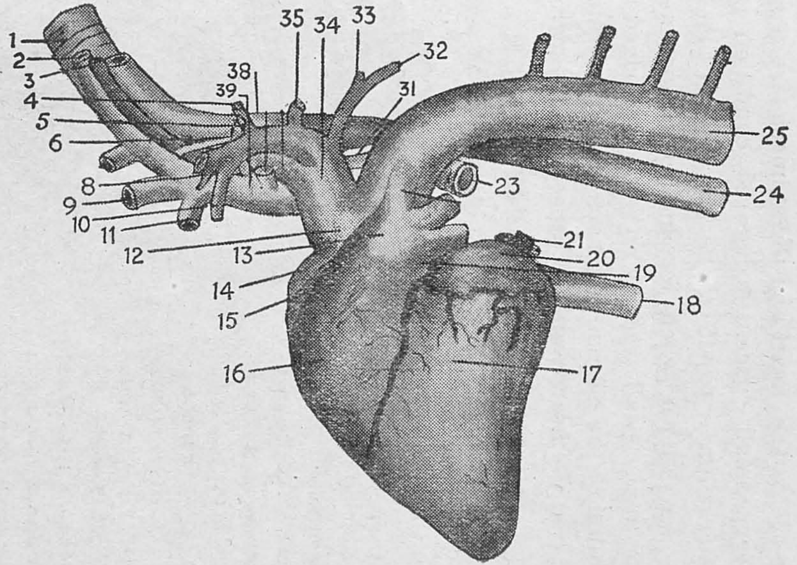


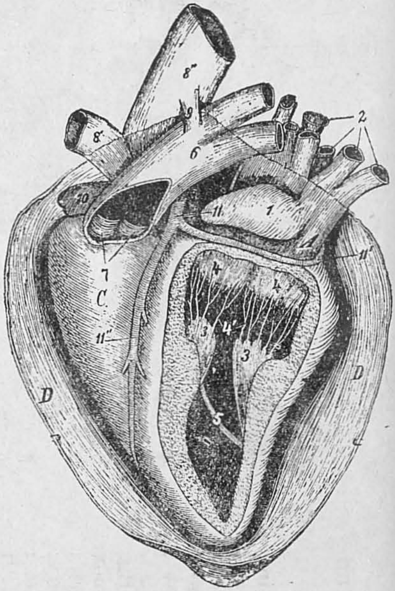
Fig. 59. The heart and the great vessels.

1. Trachea ; 2. Jugular vein ; 3. Common carotid artery ; 4. Vertebral art. ; 5. Vertebral vein ; 6. Thoracic duct ; 8. Ext. thoracic art. ; 9. Axillary vein ; 10 Int. thoracic art. ; 11. Int. thoracic vein ; 12. Common aorta ; 13. Pulmonary art. ; 14. Right auricular appendix ; 15. Right coronary art. ; 16. Right ventricle ; 17 Left ventricle ; 18. Post. vena cava ; 19. Left coronary art. ; 20. Left auricular appendix ; 21. Pulmonary veins ; 23. Left. bronchus ; 2 . Œsophagus ; 25. Post. aorta ; 31. Thoracic duct. 32. Subcostal art. ; 33. Dorsal art. ; 34. Ant. aorta ; 35. Sup. cervical art. ; 38. Left axillary art. ; 39. Ant. vena cava

In the ox the heart and the stomach are separated by a very small space. A diseased condition of the stomach is likely to affect the working of the heart. Cases are known when foreign bodies such as hair-pin or nail, swallowed by an ox, got lodged in the **reticulum** or the second stomach and perforating it punctured the heart wall and caused death slowly.

Fig. 60. Heart seen from the left side.

A. Left auricle ; B. Left ventricle ; C. Unopened right ventricle ; D. Pericardium ; 1. Left auricular appendix ; 2. Pulmonary veins ; 4. Mitral valve ; 6. Pulmonary artery ; 7. Its semilunar valve ; 8. Common aorta ; 8′ and 8″. Anterior and posterior aorta ; 10. Right auricular appendix ; 11. Left coronary artery ;



The heart is encased in a smooth bag called **pericardium** which is attached to its base where the blood vessels enter. The heart is a wonderfully powerful pump. Unlike ordinary pumps, it has no piston. The muscles of the heart relax, forming a cavity, in which blood flows. As soon as it fills, the muscles of the heart contract, the walls of the cavity

collapse and blood in it is squeezed out. By a proper arrangement of the chambers of the valves, complete operation of circulation is maintained.

The heart consists really of two pumps put side by side. One is for receiving the return blood or veinous

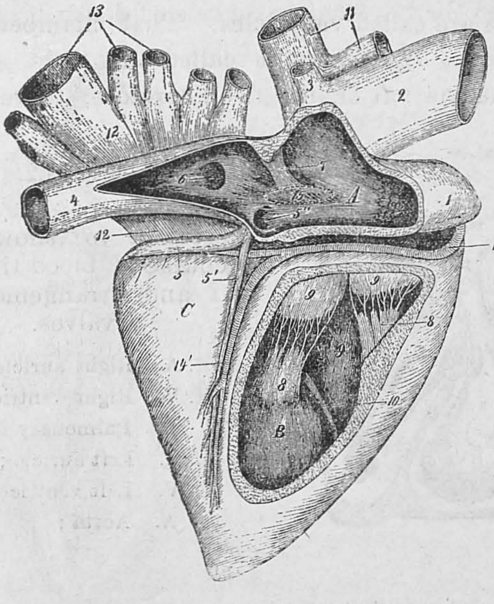


Fig. 61. Heart seen from the right side.

A. Right auricle ; B. Right ventricle ; C. Unopened left ventricle ; 1. Right auricular appendix ; 2. Anterior vena cava ; 4. Posterior vena cava ; 5′. Right coronary vein ; 5. Tricuspid valve ; 11. Anterior and posterior aorta ; 12. Left auricle ; 13. Pulmonary veins ; 14. Right coronary artery ; 14′. Right coronary artery and vein.

blood from the body and forcing it into the lungs for purification by absorption of oxygen from the inspired air. Another pump is for receiving oxygenated blood

from the lungs and forcing it into the arteries or the great blood vessels which carry blood to all parts of the body. Each chamber of the heart is, therefore, subdivided into two chambers, one for receiving blood and the other for forcing it out. The receiving chambers are called **auricles** and the forcing chambers are called **ventricles.** That chamber which is put on the right side is called the right and the other one the left chamber. Therefore, there are the

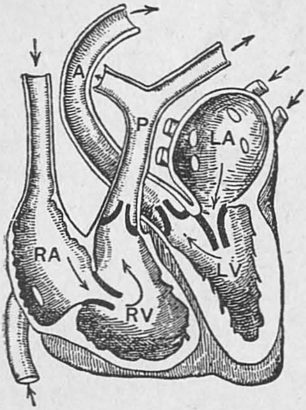


Fig. 62.
Diagram of the heart section to show the course of blood through it and arrangement of valves.

R. A. Right auricle ,
R. V. Right ventricle ;
P. Pulmonary artery ;
L. A. Left auricle ;
L. V. Left ventricle ;
A. Aorta ;

right auricle and **right ventricle** and **left auricle** and the **left ventricle.** The receiving chambers, because they have an ear-shaped attachment, are called **auricles.** The name **ventricle** comes from **ventriculus**—a little stomach. The heart of the full grown ox weighs 5 to 7 lbs.

The main pipes through which the return blood enters the right auricle are called **vena cavæ.** There are two of them connected directly with the right

auricle. The **superior vena cava** comes from the upper and the **inferior vena cava** comes from the lower organs.

The passage through which blood from the right heart passes to the two lungs is called **pulmonary artery** and the return path of the purified blood to the left heart is called **pulmonary vein.** The main blood

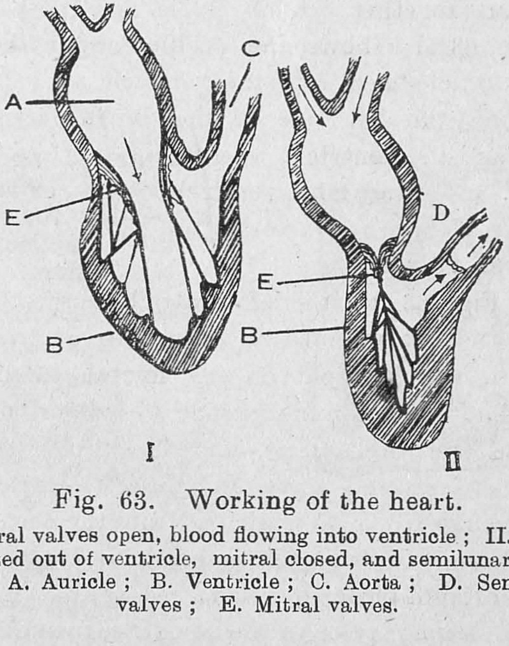


Fig. 63. Working of the heart.

I. Mitral valves open, blood flowing into ventricle ; II. Blood squeezed out of ventricle, mitral closed, and semilunar valves open. A. Auricle ; B. Ventricle ; C. Aorta ; D. Semilunar valves ; E. Mitral valves.

vessel through which the blood is forced from the left ventricle is called the **aorta.**

It rises up, gives off two branches for the fore part of the body and then turns down in a sharp arc and passes on giving out branches called arteries to feed the organs to the hinder parts from the heart.

Any mechanism for pumping must have valves and the heart has also got them. These valves are made of strong membranes in the shape of pockets which permit the passage of blood in one direction only. There is no communication between the right and the left chambers of the heart. The two are quite separate, although their relaxation and contraction take place together.

Fig. 63 (I) shows the position when the valves of the auricle open into the ventricle. The **mitral** valves of the left side of the heart between the **auricle** and the **ventricle** open, allowing free passage of blood into the left **ventricle.** The exit to the **aorta** is closed by valves which are called **aortic semilunar valves.**

In Fig. 63 (II) the left ventricle is shown filled. Immediately it is filled it begins to contract and forthwith the **bicuspid** or the **mitral** valves close down shutting communication between the left ventricle and the auricle, and the three semilunar valves between the aorta and the left ventricle open up allowing blood to rush past into the **aorta.** The contraction of the left ventricle continues till the last drop of blood in it is forced out. While this action is taking place in the ventricle, the auricle has begun to fill itself from the supplies of blood from the pulmonary veins from the lungs.

In the heart the valves are tied to white cords passing from them to little projections or columns on the walls of the ventricle. The walls of the aorta and the arteries are strong and stiff. They do not collapse.

With each forcing out of blood from the heart there is a sudden pulsation and at every pulsation the apex is pressed against the chest wall. The impact of the apex against the chest wall is audible. When the cardiac impulse is felt, two sounds are heard. The first one is dull and relatively long and the

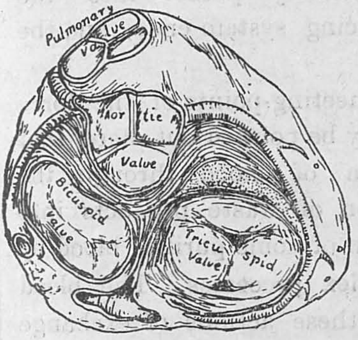


Fig. 64. Base of the ventricles showing aortic, bicuspid, and tricuspid valves.

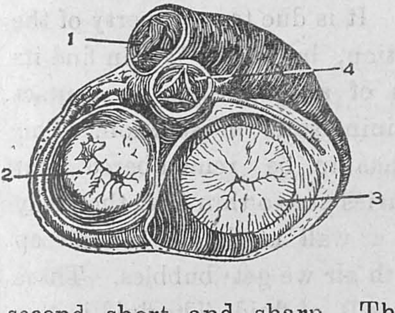


Fig. 65.
Section of the heart through the auricles.

1. Pulmonary valves ;
2. Bicuspid (mitral) valves ;
3. Tricuspid valves ;
4. Aortic valves.

second short and sharp. The two sounds succeed each other very rapidly and are followed by a long but brief pause. The two sounds are likened to 'lub', 'dub'. The first long sound 'lub' occurs when the ventricles are contracting and is caused by the rumbling of the muscular tissue and by the vibrations

of the mitral and tricuspid valves set up by pressure on them.

The second 'dub' is caused by the semilunar valves of the aorta and pulmonary artery being thrown into vibration by their sudden closure.

The blood from the arteries flows through many branches and then ultimately passes into the capillaries. There the forcing system ends, and the return system begins.

The capillaries are the meeting-points of the force and return systems. It may be pointed out here that the continuous circulation of blood through the capillaries and the absorption of waste products into the blood and the absorption of some purified blood by the muscles are very complex processes. The blood from the artery performs these actions of exchange without leaving its own channel, i.e., the capillaries, but remaining within it. It is due to a property of the blood or any salt solution, by which it can find its way through the pores of a diaphragm in contact with another fluid containing salts in solution. This is called **osmosis.** It has to be remembered that the walls of the capillaries are so thin that they may be regarded as almost a wall of fluid. When soap solution is blown into with air we get bubbles. These bubbles are sacs having walls of fluid. The fluid in this instance serves as the wall of a vessel. The walls of the capillaries may be imagined to be of almost this texture. Any way, blood in the capillaries react on the surrounding mass of flesh containing **plasma** or fluid and absorbs the carbon dioxide from the plasma

into itself. Carbon dioxide is produced by the oxidation work performed by the blood on the muscles. The blood gets changed in colour to blue by the absorption of carbon dioxide and then begins the return journey. The capillaries gradually open up to conduits of larger and larger bore called veins which allow the return passage of blood to the heart.

Some important veins : The veins from the right and left fore-limbs are called right and left **subclavian veins.** The veins of the head and neck are the **external jugular veins.** The veins from the head, neck and the fore-limbs unite to form the **superior vena cava.** The veins from the posterior portion of the body unite to form the **inferior vena cava.** The veins from the **posterior** limbs do not come back directly to the heart but perform some work about the abdominal region concerning the digestive and excretory systems.

The veins from the kidneys and another vein just near the diaphragm called the **hepatic veins** from the liver pour blood into the inferior vena cava. The veins from all other organs, the stomach, the intestines, the spleen and the pancreas etc. unite to form the **portal vein.** The portal vein goes to the liver not to drain it but to meet there in the capillaries the red blood from the **aorta.** There it performs many wonderful processes and comes out by the hepatic vein to be poured into the inferior vena cava.

The veins have pocket-like valves which work only one way so that no blood in the vein can return back.

1269. BLOOD PRESSURE.

The pressure put on the elastic conduit pipes for blood or the arteries is the **blood pressure.** During life these conduit pipes are more than full ; they are always under pressure and distended. This pressure is called the blood pressure. With each beat of the heart, a fresh quantity of blood is thrown into the aorta. The arteries are already distended and this beat gives them a further distension. The extra quantity of blood flows into the arteries and into the capillaries in the form of a wave. This wave after wave of blood create **pulsation** in the arteries. This may be felt by pressing any convenient artery. In the ox the artery passing below the **inferior maxilla** or the one just under the tail at its beginning can be conveniently felt.

The bores of the arteries are automatically controlled by the nervous system. Thus when food gets into the stomach, it needs more blood than when it has less work to do. The blood vessels automatically dilate allowing more of the circulated blood to pass through the stomach, and other organs necessarily receive proportionately less. This is brought about by controlling the aperture of the arteries by the nervous mechanism.

1270. COMPOSITION OF BLOOD.

Blood is a warm, red liquid in mammals which carries nourishment to every part of the body. It is homogeneous and alkaline and salty. It runs through the arteries, the capillaries and the veins, and supplies

nutrient materials as oxygen, carbohydrates, proteids, fats and salts to the cells and tissues. Blood carries away waste materials like carbon dioxide, and urea from the tissues.

The blood of the ox has a specific gravity of 1060, and its normal temperature when felt outside at the anus is 102°F. Blood forms thirteenth part or 7·71 per cent of the weight of the body of the ox. Every part of the body, every part of the various organs, is steeped with and saturated in blood.

Blood contains **red** and **white corpuscles** and the **plasma** or the fluid matter which is a mixture of water, **albumin,** salt and **fibrin.**

If a pin is made to prick the skin anywhere it will be seen that blood begins to flow, but almost immediately this ceases. Blood clots on coming outside its own channel, whether inside or outside the body. The **clotting** prevents further flow of blood from a wound. Calcium salts to a certain stage increase the coagulability of blood.

If blood is allowed to clot and left for some time a fluid separates out from it. This is the **serum.** The clot consists of the blood corpuscles and **fibrin.** Serum, therefore, is plasma minus fibrin. It is the fibrin that helps the clotting of blood. The blood from which fibrin has been separated by stirring with a stick will not clot. In dropsy and some other diseases the fluid that accumulates is serum which consists of water, salt and albumin.

The white corpuscles of blood are very interesting substances. They can be seen under the microscope.

In the blood in living animals these are capable of amœboid motion and may be seen to change shape under the microscope. When they find difficulty in passing through the tiniest tissue they will squeeze to adapt themselves to the aperture. These are called **phagocytes** or **leucocytes.** These white corpuscles fight poison, bacteria etc., enclose them in their body and destroy them. There is, on the average, approximately, one white corpuscle to 500 red corpuscles, varying from 1 : 300 to 1 : 700. In diseases where there is internal infection the number of white corpuscles increases.

The red corpuscles of the ox are flat bi-concave discs and possess no nucleus. There are 50 lakhs of them in one cubic millimeter of blood. Briefly speaking, blood performs the following functions :

(1) The transport of oxygen to and from the tissues and lungs. (2) The destruction of harmful germs. (3) The distribution of nutrition throughout the body. (4) The removal of waste products from the tissues.

1271. THE LYMPHATIC SYSTEM.

The fluid that exudes from blood vessels is called **lymph.** It is the substance that circulates through the tissues. It may be regarded as the material through the agency of which the tissues are directly nourished and by which the waste materials are collected from the tissues and taken back into the blood stream. There are certain tissues which are not provided with blood supply but only with the

lymph material of the blood. The lymph is derived from the blood stream.

The lymph lies in spaces between the cells of the tissues and these are drained by a net-work of delicate vessels called the **lymphatic vessels** which unite with one another to form a few main lymphatic vessels. By these lymph vessels lymph is carried away from the tissues or organs. The lymphatic vessels in the body are connected with each other, the main vessels lying in the abdomen in front of the vertebræ. This is the **thoracic duct.** The various ducts ultimately open into the vena cava so that the lymph that exudes from the blood capillaries is returned to the blood when it has discharged the function of supplying nourishment to the cells. The plasma coming out of the capillaries feeds the tissues with what is necessary and the excess passes through the lymphatic glands and ducts.

1272. LYMPHATIC GLANDS.

Along the course of the lymphatic ducts small bean-shaped bodies are found. The lymphatics enter into them by one side and leave them by the other. These are the **lymphatic glands.** Here in some of these the colourless cells of the blood are made. The glands play a very important part in the working of the several systems.

1273. THE RESPIRATORY SYSTEM.

The capillary tubes or the thinnest blood vessels have the property of permitting outside gas or liquid

to pass into or out of them. Upon this phenomenon depends the mechanism of the circulatory and the respiratory systems. If some blood is taken out and is not allowed to coagulate by the addition of some chemicals and then be hung up in a bladder in an atmosphere of carbon dioxide, it will be seen that the gas is affecting the red blood in the bladder and making it blue. The bladder does not permit the liquid to ooze out yet allows the surrounding gas, in this instance, to work through the bladder. Liquids containing salt substances also behave in the same manner, i.e., act and react upon another saline solution placed in a bladder if it is in contact. This is what is constantly taking place in the capillaries. Remaining within the walls of the capillaries blood is feeding oxygen to the tissues and taking back the waste materials into itself as also the exuded carbon dioxide gas from the surrounding nourished tissues. Carbon dioxide gas has the property of changing the red colour of blood to blue. The arterial blood containing oxygen by reaction on the tissue substance gets deprived of its oxygen. This oxygen burns the tissues, forming carbon dioxide gas, which returns back to capillaries and makes its way to the lungs through the veins. This blue blood is useless for further feeding or burning the tissues and, therefore, a mechanism is to be used for its revival by which the absorbed carbon dioxide may be thrown out and another dose of oxygen taken instead. This mechanism is the one of respiration. The right heart pumps blood into the lungs for rejuvenation and the left heart, receiving

the rejuvenated blood, sends it for circulation through the aorta and the arteries.

1274. THE LUNGS.

The **lungs** are spongy masses in which air can get in. In the ox the lungs are not equally balanced. On the contrary, there is a great disproportion in size. The right lung weighs about half as much again as the left one. They are divided into lobes by deep fissures. The left has three lobes and the right has four or five. On the left side of the cavity of the chest lies the heart, and the space occupied by it makes the left lung to take a smaller space.

The lungs are firmly anchored in their position by their roots to the heart and the trachea and by the pleura to a longitudinal partition running vertically from front to back. The air chambers are called **alveoli.** Here air comes in contact with the blood, spread out side by side with it in the capillaries. The blood gets rid of its carbon dioxide and takes oxygen from the alveoli, and becoming red, returns to the left auricle of the heart as purified red blood, ready to be immediately sent back through the aorta and the arteries to the capillaries to perform the function of feeding and nourishing and of draining waste materials from the tissues.

The process of respiration consists of **inspiration** of fresh air into the lungs which become distended and filled with air and of **expiration** by which the changed air, containing carbon dioxide from the blood, is thrown out by the act of squeezing of the lungs.

These processes are usually automatic and are controlled by a mechanism inside the body which makes the lungs, when in health, work rhythmically and according to necessity. Man can accelerate or hold their respiration voluntarily for a few minutes only.

We shall now examine the various organs and their functions that come into play in respiration.

Fig. 66. The Lung of the Horse.

a. Apex; b. Notch for heart; h. Outer surface showing grooves made by pressure against ribs.

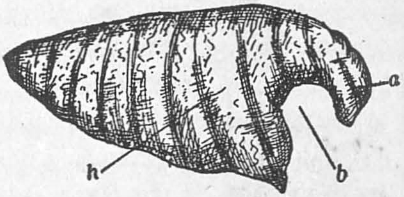
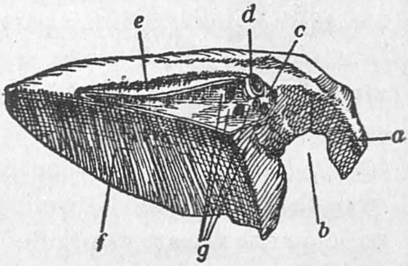


Fig. 67. The Lung of the Horse.

a. Apex; b. Notch for heart; c. Left pulmonary artery; d. Left bronchus; e. Œsophagal groove; f. Diaphragmatic surface; g. Pulmonary veins.



The air is sucked through the nose. At its entrance the **nose** is divided into two chambers. Air passes through them and coming in contact with the nasal walls becomes warm, for, the nasal walls have membranes in which blood is circulating for that purpose. It contains some hairs which serve to filter the incoming air of its dust and dirt.

1275. THE TRACHEA.

The air from the nose passess on and strikes the **pharynx** and goes down into the **larynx** or the voice box, and from there enters the **trachea** or the main air canal. The smaller particles of soot and dust that escape the hairs in the nostrils, get entangled on the sticky surface of the pharynx. The trachea is like a piece of armoured hose containing open

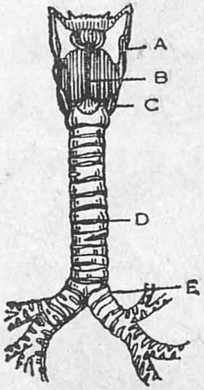


Fig. 68.
Trachea and bronchi.
A. Larynx ;
D. Trachea ;
E. Bronchi.

Fig. 69. Diagram to show the distribution of the bronchial tubes throughout the lungs.

rings of cartilages. The **trachea** divides itself into **bronchiæ**, which are air passages taking air into the lungs. Two bronchiæ pass on to the two lungs and a third bronchi in the ox, a specially small one, goes directly into the most anterior lobe of the right lung.

Air may also be taken in by the mouth. On the upper wall of the cavity of the mouth is the palate

which separates the nasal chamber from the mouth. Behind the palate is the soft palate which is a thin piece of muscle. The soft palate hanging down like a screen may separate the mouth from the pharynx.

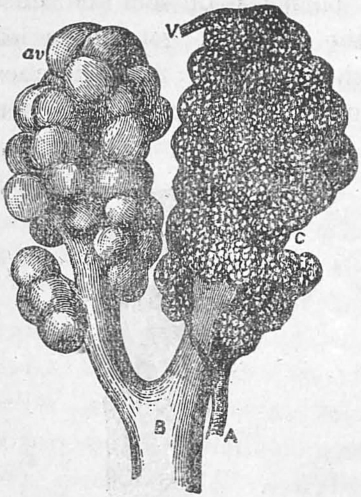


Fig. 70.

The outer surface of two infundibula in a lobule of the lung.

A. Branches of pulmonary artery ramifying over the air alveoli ; B. The small bronchial tube of the lobule ; C. Capillaries; av. Air vesicles or alveoli ; v. A terminal bronchiole.

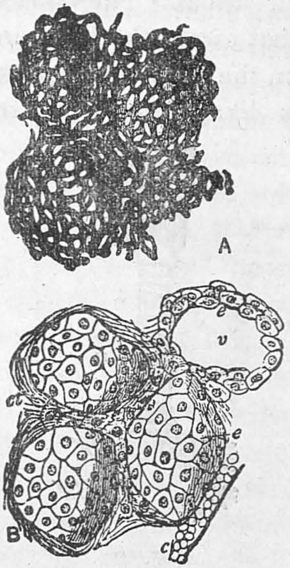


Fig. 71.

The capillaries and the air cells of the lung.

A. The dense mass of capillaries round the air cells ; B. The flattened plate-like cells of which the air cells are made.

The air after striking the pharynx finds two passages before it, the œsophagus and the larynx. The in-going air by suction from the lungs passes down the larynx into the trachea. The trachea is

lined with a hair-like process called the **cilia**. These become straight and then bend down and in this operation move up any liquid in it towards the mouth. The cilia are constantly in motion during the life of an animal. The bronchiæ are divided and sub-divided into smaller and smaller diameter, and as the tubes get smaller their cartilage bands get less and less complete and ultimately disappear within the smallest tubes. The finest bronchial tubes end in a cluster of dilated branches. These are called **infundibula.** Cavities in the infundibula forming so many chambers are called **alveoli**. Into these the bronchial tubes supply air.

The lungs are made of an enormous number of these alveoli connected by connective tissues. The whole of the lungs is covered by a membrane called **pleura.** The walls of the alveoli made of fine elastic tissues are lined with a net-work of blood vessels. The interaction between blood and air takes place here.

The thoracic cavity is without air and there is no atmospheric pressure in it. On the other hand, the lungs are filled with air and is in free communication with the atmosphere. The absence of pressure outside the lungs in their case or the thoracic cavity, and the presence of pressure within the lungs, make the lungs inflate, much as a foot-ball bladder inflates by forced air. The inflated lungs fill up the thoracic cavity much in the same way as an inflated bladder fills up the cavity of a foot-ball.

If the casing of the foot-ball could be extended the bladder would further expand and fill up the

extension also. In a foot-ball the leather casing is not expansible. But in the case of the lungs its casing or the thoracic cavity can be expanded and contracted by the play of the muscles of the rib and of the dome of the diaphragm. Therefore, when the thoracic cavity expands, the lungs also expand and draw in air from outside through the trachea, and when the cavity contracts the lungs also contract and squeeze the air out of it through the trachea into the atmoshpere.

The mechanism of breathing consists in expanding and contracting the thoracic cavity. The thoracic cavity is bounded by ribs and by the diaphragm. The ribs are connected obliquely, forming an oblique case. When the ribs are pushed up, thereby making the ribs less oblique, the chest becomes wider. The diaphragm is not a straight screen but is dome-shaped. The dome is on the side of the thorax, encroaching on its space. When the partition contracts, the dome becomes flattened and the whole diaphragm descends, and thereby increases the capacity of the chest. By this joint action **inspiration** takes place ; on the contrary, when the ribs fall back to their original positions

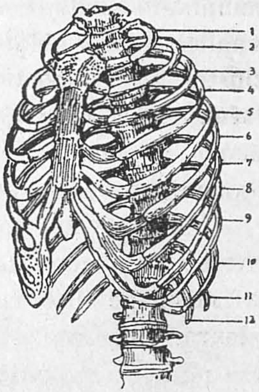


Fig. 72.

The thoracic cavity of man.

The cage of ribs is shown which when forced up expands the cavity and when forced down contracts it.

and the diaphragm relaxes, the capacity of the lungs is diminished and the lungs are squeezed out to occupy a smaller space, when **expiration** takes place.

This action takes place automatically and ceaselessly during life. It is controlled by nerves, the centre of which is in the medulla and is called the centre of respiration. When standing quietly, the ox draws breath 12 to 16 times per minute. During exercise the breathing is quicker, for, the tissues require more oxygen and the heart and lungs have to work harder to meet the demand.

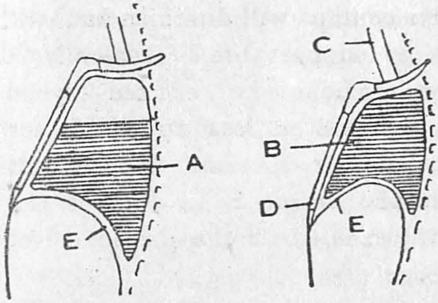


Fig. 73.
Diagram of chest and abdominal wall showing changes in inspiration and expiration.

A. Inspiration ;
B. Expiration ;
C. Trachea ;
D. Sternum ;
E. Diaphragm .

During expiration or exhalation impure air is thrown out of the lungs. The air enters the lungs and gives up its oxygen to the blood and takes up carbon dioxide so that the exhaled air is richer in carbon dioxide than the fresh air. If the same air is breathed in and out it will be denuded more and more of its oxygen and become unfit for supporting life. When a fire burns the same phenomenon takes place, namely, the consumption of the oxygen of the air.

The lungs retain a large part of its content of air when expiration occurs. Generally 10 per cent of the air space is replaced in each respiration. This quantity of air which comes in and goes out at each breathing is called tidal air. In a medium-sized ox or horse at repose the quantity of air exhaled at each breath is 7 pints. In an hour an ox or a horse will breathe in or out 80 to 90 cubic feet of air. During this period of one hour an average animal will use up from the tidal air about 3½ cubic feet of oxygen and will produce about 3 cubic feet of carbon dioxide.

As has been said, if the same air is breathed again and again its oxygen content will diminish and will, therefore, be unable to support life. Generally, a percentage of carbon dioxide may be fixed beyond which the air will be more or less unsuitable for breathing. Normally the air contains ·02 per cent carbon dioxide. In the inspired air this is the percentage. But in the exhaled air the percentage of carbon dioxide is 4·38.

In order that proper health be maintained, the atmospheric air should be so changed by ventilation that the content of carbon dioxide does not exceed ·05 per cent. In order to ensure this an ox should be supplied with 15,000 cubic feet of air. If it is supposed that there will be ten changes of air of the room per hour by proper ventilation, then the space alloted to each horse or ox in the byre should be 1,500 cubic feet. If the space allowed is less, then there should be more changes of air per hour. But more than 10 changes of air per hour is not conducive

to health, there being too much draught to ensure the maximum allowable content of carbon dioxide in the air.

The air passages are covered with mucous membranes. When the membranes get inflammed there is profuse flow of mucus and there is swelling also. **Catarrh** is an inflammation. It is infectious and is of bacterial origin. The offending bacteria are probably always present in one portion or other of the nose. Any predisposing cause gives the bacteria opportunity to begin to be offensive. If the bacteria are present in smaller numbers in isolated colonies then there is generally immunity from attack. The inflammation of catarrh may affect the nasal sinuses. Infection by droplets may spread to other animals in the herd. Catarrh leads to influenza. A little precaution at the earlier stage prevents serious developments. The seat of infection is the nose. It should be kept in a disinfected condition by applying a germicide like thymol dissolved in oil. In serious cases the infection may travel deeper down to the respiratory tract causing bronchitis and may further lead to the lodgment of pneumococcus bacilli in the lungs causing inflammation of the lungs, when **pneumonia** may develop. It is a serious disease. It may run its course and spend itself out or the animal may succumb. An attack of pneumonia makes the lungs susceptible to further attacks of pneumonia or to other lung diseases. It is really the resisting power of the respiratory organs that wards off probable attacks of various respiratory diseases.

Dust in the air causes irritation, and this may give a start to catarrh and then in a chain the other serious developments may occur.

1276. THE DIGESTIVE SYSTEM.

The digestive system commences with the mouth and ends in the rectum.

Food is received by the mouth. And the mouth is designed for the food suitable to the animal. In the herbivora, of which the ox is one, there are certain peculiarities of the mouth which distinguish them from the carnivora, both in the manner of receiving the food and of treating it there prior to swallowing. And almost at every stage of the digestive tract these peculiarities will be observable.

The digestive tract may be divided into the mouth, the œsophagus or gullet, the stomach, the intestines and the supplementary structures of the salivary glands, the liver and the pancreas.

The lips, the tongue and the teeth are the organs of prehension or organs for grasping the food and treating it in the mouth. The lips of the horse are thick and mobile and possess acute power of sensation, whereas the lips of the ox are thick and immobile. The horse's tongue has a smooth covering and is broad at the apex. It is seldom protruded. The tongue of the ox, on the contrary, is tapering and is capable of movement and is easily protruded. The tongue of the ox has a strong, rough covering. The tapering, protrudable, mobile and rough tongue of the ox allows it to have a better grip of the herbage.

The rough covering of the tongue protects it from injury while collecting the grass in grazing. The inside of the mouth of the ox has **papillæ** sloping inwards. These help to prevent the food from slipping and falling off. The incisor teeth of the lower jaw of the ox is loosely fixed and meet the dental pad obliquely. This prevents injury to the dental pad. It has been shown while dealing with

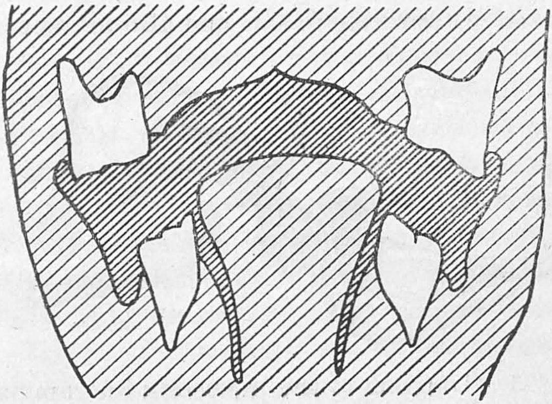


Fig. 74.
Diagram showing relative widths of the lower and upper jaw in the Ox.

the bony structure of the mouth that the ox has no front teeth in the upper jaw. There is only a hard plate where the teeth otherwise would have been. The horse has incisors in both the upper and lower jaws. These are used to bite the grass in grazing. The horse crops closer than the ox. It is, therefore, that in the grazing field which the horse has grazed,

little is left for the ox. Similarly, the sheep and the goat with their thin lips can approach the ground still closer and cut the grass closest and, therefore, where goats or sheep have grazed, little is left for the horse to bite at and still less for the ox.

In the herbivora the upper and lower jaws do not move simply up and down but the complex joint of the lower jaw with the fixed upper jaw allows the movement in mastication not only to be up and down, but lateral or from side to side and also to some extent

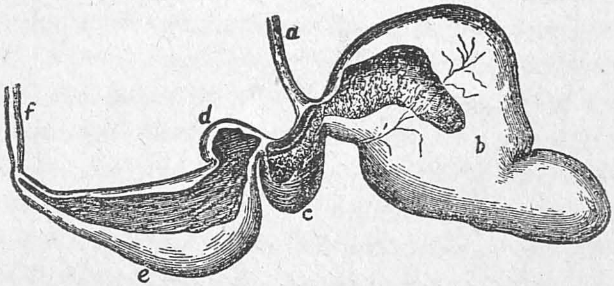


Fig. 75. Diagram of the stomach of a ruminant.
a. Œsophagus ; b. Rumen ; c. Reticulum with œsophagus groove ; d. Omasum ; e. Abomasum ; f. Duodenum.

from front to rear. This freedom of movement is more marked in the ox than in the horse.

In the herbivora the lower jaw is narrower than the upper, so that when the molar surfaces of the upper and lower teeth meet on one side they do not come in contact on the other side. Mastication is on this account always on one side, either in the right cheek or on the left. The lateral movement of the teeth in mastication causes the inside of the lower and

the outside of the upper molar teeth to have greater wear and tear, and their surfaces become slanting rather than remain horizontal by use.

Salivary glands : Three pairs of salivary glands pour their secretion into the mouth ; they are the parotid, submaxillary and sublingual.

The œsophagus is a tube with muscular walls which is lined by scale-like (squamous) epithelium. The lumen or bore of the œsophagus becomes narrow before its entrance into the stomach in the case of the horse. But, in the ox the lumen or the bore of the œsophagus is wider and more dilatable than in the horse.

The stomach is naturally a dilatation of the œsophagus. In the ox there is not one but four dilatations of the œsophagus. They are called the four stomachs, although the fourth one is the stomach in the real sense. The four stomachs are the **rumen**, the **reticulum**, the **omasum**, and the **abomasum** which is the fourth or the real stomach.

The rumen or 'Paunch' or the first stomach is a great sac having a capacity of 30 to 50 gallons, according to the size of the ox. It contains large muscular bands in its wall, enabling it to contract on its contents and give motion to them. The rumen lies on the left side of the body occupying the whole of the left side of the abdomen, and even stretching across partly to the right side of it. It is a very large sac. It is divided into two portions, the upper or the dorsal sac and the lower or the ventral sac. Each has a blind sac at its end. The sacs are lined with

mucous membranes, possessing papillated, stratified squamous or scaly epithelium. The entrance of the rumen is from the œsophagus and its exit is into the reticulum or the second stomach.

1277. THE RUMEN.

The food received into the **rumen** is stored and churned in it till such time as the ox finds convenient for rumination. Rumination or chewing the cud is a process by which portions of the food from the rumen are regurgitated into the mouth in small boluses for thorough mastication. The ruminating animals like the ox take their food and swallow them in the first instance after roughly allowing it to be treated with sufficient saliva in the mouth to be swallowed. By quick swallowing the ox finishes its meal rapidly and then leisurely brings out portions of food from the rumen and does the cudding, and then sends the food down again to the rumen or reticulum. While a bolus is regurgitated from the rumen into the œsophagus it is masticated thoroughly. Each morsel occupies ½ to 1¼ minutes for chewing during which time the ox makes 30 to 60 chewings or grindings. Then the bolus is rolled up by the tongue and swallowed. Because of the provision of the rumen and of later rumination of the food first swallowed, the ox can, in the first instance, eat food nearly three times as quickly as the horse can. The horse has to completely masticate before swallowing. The œsophageal lumen of the ruminants is provided with a groove which opens into the various stomachs.

It should be observed that when, after a feed, the animal is comfortable and undisturbed it is then only that it begins the rumination or chewing the cud. The flow of saliva and the process of rumination ceases in disease or discomfort. Under these conditions the food may become dry and caked, and set up inflammation.

When during disease, therefore, the animal shows a moist mouth on account of the flow of saliva, and begins to ruminate, the indication is that the animal is comfortable and the disease has ceased to disturb it painfully at that stage.

The ox spends about seven hours out of the twenty-four hours of the day in ruminating. The ox regurgitates for rumination a bolus of about $3\frac{1}{2}$ ounces (100 grams) at a time. It takes usually rather less than one minute to masticate it and re-swallow it, although the range of time is from $\frac{1}{2}$ to $1\frac{1}{4}$ minutes. There is one peculiarity of the ox about regurgitation of food. It is that although it can ruminate by bringing out food into the mouth from the rumen, it cannot vomit even when the distension of the rumen causes distress. It has been suggested that the vomiting centre in the medulla in the ox is undeveloped.

While the food is churned about in the rumen, no digestive juice is secreted, the only fluid added to the food being the alkaline saliva from the mouth.

When dry food is eaten, the ox can secrete as much as 50 litres or 10 gallons of saliva in 24 hours. The flow of saliva is, indeed, very large in the ruminants.

In human beings taking starchy food, the saliva contains ptyalin which begins to react upon the starch as soon as the food comes in contact with it in the mouth. But the saliva of the ox contains hardly any ptyalin enzyme.

There is a theory about the provision by nature of the process of rumination in the ruminants. It is that the ruminants in their natural state have to

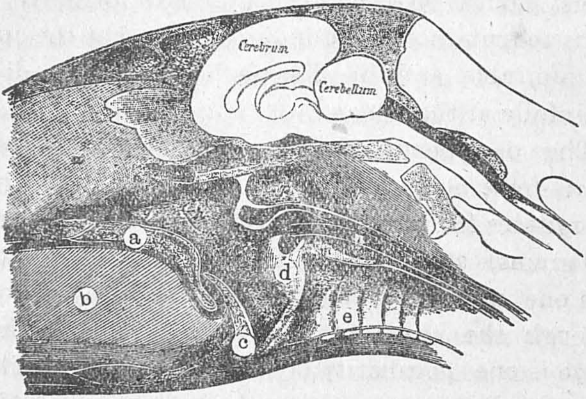


Fig. 76.
Diagram of a section of the head of the Horse.
a. Long soft palate ; b. Tongue ; c. Epiglottis ; d. Arytenoids ; e. Trachea.

graze in constant fear of being killed by the larger carnivora. It is, therefore, that they developed the rumen in which they thrust their food quickly and then after retirement to a comparatively quieter place of safety, they ruminate and carry on the digestive process at ease. But it is merely a theory with little to justify it on scientific grounds, now known. The

rumen is a necessity, and the ruminants can chew leisurely at the first intake even when in a domesticated condition. They do not do so, but swallow in the first instance for the rumen and then ruminate the food afterwards. In the rumen, while there is no digestive juice, there are myriads of bacteria for reacting upon the food material. The swarm of bacteria attack the cellulose of the forage, breaking them up into various organic acids, chiefly acetic and butyric acids. These combine with the alkali of the saliva, and the resulting salts are absorbed from the intestines, providing sources of energy. It is estimated that 60 per cent of the cellulose of the food is disintegrated in the rumen. As the cellulose is broken down, the contents of the cells are liberated and rendered accessible to the digestive juices in the subsequent parts of the digestive tract.

In the rumen, in addition to the cellulose, strach and sugars also undergo destructive fermentation. Nitrogenous matter is also broken down by bacteria and is used to build up the proteins for their own protoplasm. When a plentiful supply of soluble nitrogen is available, the bacterial multiplication and activity increase and more cellulose is disintegrated in a given time.

Rumination commences half an hour after the feeding ceases and probably continues till the coarser constituents are re-chewed or until the animal is disturbed. This fact is of considerable importance in dealing with the oxen, particularly with those used for draught and the plough. They should be

given at least 2 hours rest after a feed before they are disturbed. Disturbance will prevent rumination, inducing stomach disorders, malnutrition and disease.

At birth the compartments of the stomach are not devoloped in the ox. The natural food of the calf is milk. The milk goes past the undeveloped first two stomachs of the calf and gets into the third or the fourth stomach. The rumen is suitable for dealing with roughage only. It is, therefore, that there is the necessity of the milk drunk by the calf to go past the rumen. The slit in the œsophagus which communicates with the rumen remains firmly shut in the calf, so as to prevent milk from entering the rumen or the honey-comb, and instead to let it flow directly into the third and fourth stomachs. With the growing age of the calf, in its second or third month, the œsophageal slit slackens in elasticity and cannot close firmly to allow the liquid get past the rumen.

It was formerly believed that finely-ground food materials (concentrates) and water might get past the œsophageal slit directly into the third and fourth compartments of the stomach. But this has been disproved. It has been found that even water and ground concentrates passed through the œsophageal groove into the reticulum and the rumen. If, therefore, kernels of whole-grain escape mastication when first eaten, they are brought up for rumination only if entangled in coarse forage. Such kernels may pass through the whole digestive tract in an unbroken condition. It is, therefore, that a considerable

saving in concentrates can be made if the grains are ground and then mixed with forage for feeding the cattle.

When the bulky herbage reaches the rumen, on account of their light nature they do not sink into the fluid contents of the rumen at first. They are carried to the rear of the rumen by muscular contractions, gradually absorbing the fluid, until they sink and mix with the other contents.

In the lower part of the rumen there is a movement of the heavier food masses towards the front, where the rumen opens into the reticulum. The movements of the rumen and then of the reticulum gradually accomplish a thorough mixing up and softening of their contents.

1278. THE RETICULUM OR HONEY-COMB.

Reticulum (a little net) is the name of the second stomach of ruminants like the ox. It is also called the **honey-comb**. It lies in front of and a little below the level of the mass of the firs stomach, towards the middle of the body. It has a wide entrance from the first stomach or the rumen and a smaller one into the third stomach. Its mucous membrane lining is thrown into a large number of little pockets or cells some of which are hexagonal in outline, some square and some triangular. Again, most of these have smaller secondary cells in their cavities. The reticulum as a rule contains fluid. It may be regarded as a fluid reservoir from which liquids may be sent to the other stomachs as required. It is in the reticulum of the

camel that the water bags or cells are situated which store water for future use.

1279. THE OMASUM.

Omasum is the third stomach of the ruminants. It is situated on the right side of the abdomen at a higher level than the fourth stomach with both of which it communicates. It is also called 'manyplies' or many leaves. There are leaf-like projections in the omasum with rough rasp-like surfaces. In the centre of each folium is a band of muscle fibres which produce a rasping movement of the leaf when it contracts. One leaf rubs against the leaves on either side of it. This motion serves to grind down the food material preparatory to further treatment in the next chamber or the fourth stomach.

1280. THE ABOMASUM OR THE FOURTH STOMACH.

After receiving grinding treatment in the omasum the food enters the **abomasum** or the fourth stomach. The contents of the stomach are alkaline for some time, after being received from the omasum. Here micro-organisms break down the sugars to form lactic acid. Starch is also converted into sugar by another enzyme. But before any action occurs, the stomach actively engages in a vigorous churning movement which has the effect of most thoroughly mixing the gastric juice with the food and of breaking it up. The stomach of the ox mainly performs the preparatory process of warming up the food, mixing it with gastric juice, and of softening and thereby

converting the food material into a homogeneous mass in which, however, the particles of the various materials in the feed may be recognised.

This action of gastric juice in the stomach may be divided into two periods ; (a) amylolytic period and (b) proteolytic period. Before the amylolytic or starch-breaking period is completed, the gastric juice begins its proteolytic or protein-breaking action through the enzyme pepsin.

In the stomach the casein of milk is first coagulated and then changed into peptone. The coagulation is brought about by a ferment of the gastric juice called rennin.

Rennet, a substance containing rennin, converts caseinogen into a new, hard, coagulated substance, the casein. Advantage is taken of this property of making hard curd in the preparation of cheese. Rennet from calves' stomach is the material used for starting the curdling of milk for cheese. Rennin may not be present in the gastric juice of mature animals that are not being fed with milk or milk by-products. With the entrance of food into the stomach, not only are the gastric juice and enzymes secreted, but simultaneously a kneading action is set up. Contraction of the stomach wall starts at the middle portion and pass in waves, following one another, towards the rear end. At first the mouth of the pylorus or the exit of the stomach does not open when the squeezing action reaches it. The wave, therefore, reflects back towards the first part of the stomach, thereby thoroughly mixing up the contents.

When, however, the reaction of the juice and the enzymes has progressed sufficiently, every time the squeeze reaches the **pylorus,** a quantity of semi-fluid content is allowed to be spurted through the opening of the pylorus, brought about by the relaxation of its muscle. After a portion is thrown into the intestine, the opening of the pylorus closes. This process is repeated and becomes more and more vigorous as the acidity of the food increases by longer stay in the stomch which continues to secrete hydrochloric or gastric acid. The stomach does not completely empty itself between meals. The free hydrochloric acid has a marked antiseptic and anti-bacterial reaction. Some organisms though not killed by the acid cease to multiply, but pass into the intestine to become active again.

1281. THE INTESTINES.

That portion of the alimentary canal which is situated beyond the stomach is called the intestines. It is in the intestines that the greater portion of the digestion and absorption of food materials take place. The intestines are divided into two portions—the **small intestine** and the **large intestine.** Between the small and the large intestine lies a portion of the intestine called the **cæcum.** Cæcum means 'blind'. It is a blind portion of tube inserted at the junction of the small with the large intestines. It is very large in the horse, and there it performs the same function that the rumen does for the ox. In the ox the **cæcum** is much smaller.

In the ox the small intestine is 130 ft. long, the **cæcum** is 2½ ft. long and is followed by the **colon** or large intestine which is about 35 ft. The colon is arranged like the coils of a watch spring. It lies in the right flank of the abdomen about half way between the spine and the abdominal floor. The last fold

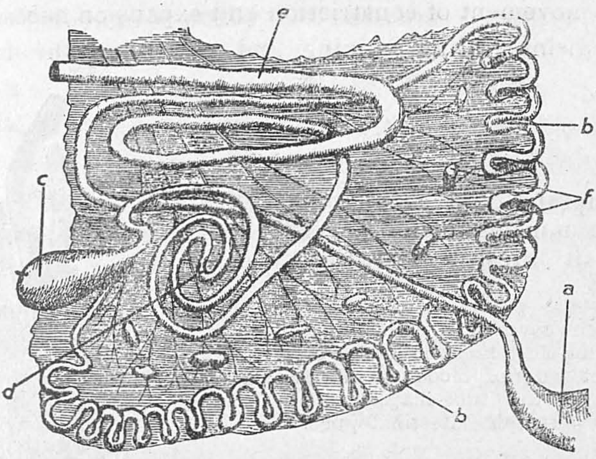


Fig. 77.

Diagram of the intestine of the Ox.

a. Fourth stomach ending in duodenum ; b. Coils of small intestine ; c. Cæcum ; d. Spiral colon ; e. Rectum ; f. Lymph glands.

approaches the lumbar region and becomes a straight pipe forming the rectum.

The wall of the intestine is made of three layers. The outer coat or layer is called the **peritoneum**, the middle layer is of muscle and forms the muscular coat, the inner layer is of mucous membrane. The

thickness of the layers of the coat in its thickest portions is about half an inch.

The outer or peritoneal coat runs continuous from the **pylorus** to the **anus.** It exudes secretions and keeps itself moist, and thereby reduces frictions against other surfaces and organs.

The muscular coat enables the intestines to have the movement of constriction and expansion necessary for disintegrating, mixing and propelling the food.

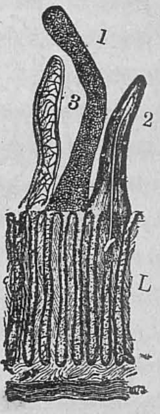


Fig. 78.
Diagram of a section through the mucous membrane of the small intestine showing three of the villi.

1. Cells covering a villus ; 2. Section showing the lymphatic vessels or lacteal ; 3. Net work of blood capillaries ; L is opposite the tube-shaped glands that secrete intestinal juice.

The movement of forwarding and squeezing food materials is called **peristalsis.** It is created by the muscles of the intestinal wall.

The mucous coat is the last surface that comes directly in contact with food materials. On this layer the various blood vessels spread themselves, providing the blood supply necessary for the digestive process. In the small intestine the surface of the mucous membrane is studded with very fine hair-like projections called **'Villi'**. They are supplied with a

net-work of capillaries and are the agents of absorption. In between these villi stand numerous intestinal glands which pour out the intestinal secretions.

The intestines are held in position by folds of peritoneum, which bind them directly or indirectly to some parts of the abdominal wall. The fold in which the free part of the small intestine hangs is called '**Mesentery**'. It is through these that the blood and lymph vessels enter the intestine. In the small intestine secretions are produced by the small glands in the lining. This secretion contains several enzymes. Here the sugars and peptones which have escaped digestion so far, are broken down. Here also the enzymes change the various sugars into glucose-like substances for absorption in the blood.

The digestion is very complete in the intestines. Most of the digested nutrients are absorbed from the small intestine before they reach the large intestine.

Movements of the villi of the intestines greatly help absorption.

The large intestine : The undigested and unabsorbed matter passes into the large intestine. Very little of the digestive process goes on here. The absorption of digested nutrients is completed in the large intestine.

Most of the bacteria in the food are killed by the acid of the gastric juice in the stomach and the small intestine.

The material now pushed into the large intestine has to stay there longer. The bacteria that are still alive multiply tremendously, specially those that thrive

without air. Even when food materials reach the large intestine without bacteria, those present in the large intestine seize the freshly-arrived materials and multiply. Normally this bacterial action is not harmful. But if the fæces remain longer in the large intestine, as in constipation, injurious substances may form and find their way into the blood stream.

In the large intestine water is extracted from the remnant food material, and normal consistency is given to the fæces. The cæcum of the ox is small and does not perform any great important function. But in the horse it is very large, and serves to a certain extent the purpose of the rumen in the ruminants. In the horses' cæcum, both enzyme and bacteria act upon the material and produce absorbable nutrients from the materials reaching it.

The discharge end is called the **anus** controlled by the **sphincter ani.** This is normally in a contracted state. The act of defecation consists in the withdrawal of the control of the nerves concerned which results in relaxation and consequent discharge of fæces.

The intestine receives partially-digested food from the stomach. We have seen that cellulose and sugars get disintegrated into simple acids and compounds by bacterial action in the rumen. The action of acid juices converts some other materials of food into absorbable condition in the stomach. But fats have hitherto resisted reaction, and the digestion of the proteins and carbohydrates has been far from complete. In the intestine is carried on the work of digestion or

breaking up even more vigorously than in the stomach. Here all classes of nutritive materials are attacked. Here again in the upper part of the intestine, at its commencement from the pylorus, it receives the digestive fluids from the two organs of the liver and the pancreas injected into it. The digestive juice is secreted from the wall of the stomach itself.

The food at the moment of its entrance into the intestine is, of course, acid. But the secretions of the intestines, those from the pancreas or the pancreatic juice, from the liver or bile and the intestinal secretion itself, are all alkaline. Therefore, the food after reaching the intestine gradually begins to lose its acid character, and those reactions depending on acid continues at a slower pace till more and more neutrality inhibits their actions. The action, however, of pepsin continues till the contents become sufficiently alkaline to check it. The walls of the intestines contract and relax and thereby produce their characteristic motion and mixing.

1282. THE PANCREAS.

The **pancreas** supplies the pancreatic juice. The pancreas or the 'sweet bread' is a gland possessing digestive functions. It is situated in the abdomen a little to the front of the level of the kidneys and a little below them. It has a reddish colour. The gland resembles the salivary glands. The pancreas is provided with ducts which unite and enter the intestines near the points where the bile duct comes from the liver. The pancreas also pours its secretion

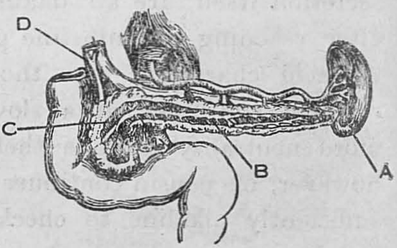
called insulin into the blood stream direct, which exercises control over the excretion of sugar in the urine. When the pancreas is diseased and is unable to function, diabetes is the result.

The most obvious function of the pancreas is the secretion of the pancreatic juice which is poured into the small intestine.

The pancreatic juice contains a combination of several enzymes one of which acts like pepsin although it is alkaline, another changes the starch into sugar, and yet another changes the fat ultimately

Fig. 79.
Diagram showing pancreas and spleen in man.

A. Spleen ;
B. Pancreas ;
C. Pancreatic duct ;
D. Bile duct.



into soluble soaps, in which reaction bile obtained from the liver also takes part.

1283. THE LIVER.

The liver of the ox has got a little sac or bile sac on its under surface in which bile is stored. It is injected into the duodenum as food passes through it into the intestines.

The liver is a solid granular organ which lies close up against the diaphragm. Its colour is bluish-purple in the ox. It is soft to the touch. It constitutes the largest gland in the body. It performs various

important functions. It forms and secretes bile. It makes **glycogen** out of the soluble sugar in the blood. Glycogen is stored in a solid form in the liver. When the soluble sugar in the blood is denuded by being used up for supplying energy, it is replenished by glycogen which is re-converted into liquid form on demand.

Liver collects the old and worn-out blood corpuscles which can function only for a limited period, so that daily a portion of the blood corpuscles gets useless for functioning. When the blood stream

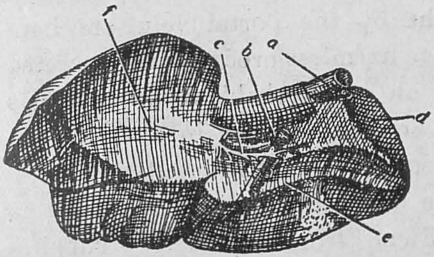


Fig. 80.
Diagram of the liver of the Horse.

a. Vena cava ;
b. Portal vein ;
c. Hepatic artery ;
d. Impression for kidney ;
e. Duodenal groove ;
f. Impression for stomach.

containing such useless corpuscles enter the liver, it arrests them from circulation, collects them and breaks them down.

The liver also functions to collect the waste materials, specially urea and uric acid, and sends them to the blood stream which are excreted from the body through the kidneys.

The sac that collects the bile is called the gall bladder. The bile is injected in the food material near the duodenum. It helps the pancreatic juice in the matter of digestion. The liver in the ox lies

almost entirely to the right of the middle line of the body. It is in contact with the diaphragm and its shape is adapted to the concavity of the diaphragm. It also comes in contact with the second and the third stomachs, the reticulum and the omasum, and bears their impressions.

Blood is supplied to the liver from two distinct sources. Blood from the stomach after its formation is poured into the portal vein. The portal vein does not pass directly to the heart, but enters the liver and is distributed into capillaries in it. Many harmful substances absorbed from the food in the stomach and intestines and brought by the portal vein are here altered in the liver into harmless products and excreted again in the bile in an unabsorbable form. Various constituents of food are also stored in the liver to be poured into the blood stream, as necessity arises.

The second source of blood supply to the liver is the hepatic artery. Blood from this artery supplies nourishment to the liver.

After the blood from each source has circulated in the liver, it is collected into the hepatic veins which empty themselves directly into the vena cava.

As has been said, liver stores sugar for the requirements of the blood stream and regulates it ; it is kept constantly at 0·6 per cent in the blood, leaving the liver.

1284. BILE.

Bile, manufactured by the liver, is, as has been mentioned, injected into the food for helping digestion.

It is a greenish yellow fluid, extremely bitter in taste and usually alkaline. Bile is exceedingly important in the digestion of fat. When the secretion of bile falls below normal, fat passes out undigested.

Bile stimulates the action of pancreatic and intestinal juices. It assists the muscular contractions of the walls of the intestines and thereby helps the passage of food through it, and it also checks putrefaction in the intestines. Waste products which would be harmful in the body are excreted by the liver in the bile. The bile is not wholly excreted in the fæces but is taken up in part by circulation and is used again.

1285. THE SPLEEN.

The spleen is an organ situated closely outside of the rumen. It is a ductless gland. Copious blood supply reaches it. It is a soft, highly vascular, plum-coloured organ. Beneath the outermost coat of the peritoneum lies a dense tissue coat, from the inner surface of which strands run into the organ. In the meshes of these strands lies the spleen pulp. This organ plays its part in the formation of the white corpuscles of the blood. It destroys old, worn-out, red blood corpuscles.

The spleen continually shrinks and relaxes every few minutes.

1286. THE EXCRETORY SYSTEM.

Kidneys and Urine

The urinary organs comprise the (1) two kidneys placed under the roof of the abdomen in the loin

region, (2) two **ureters** leading from them to the urinary bladder which lies at the entrance to the pelvis, and (3) the **urethra** which leads from the neck of the bladder to the penis in the male and the posterior genital passage in the female.

The kidneys are paired organs situated against the roof of the abdomen, generally one on either side of the spinal column. Their function is the removal of

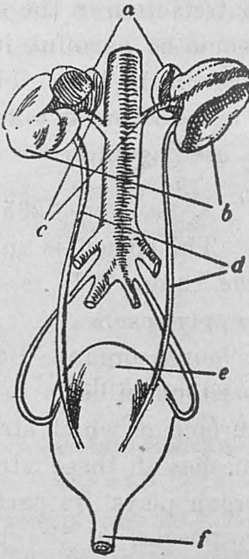


Fig. 81.
Diagram showing relations of the urinary organs of the Horse.

a. Adrenal glands ;
b. Kidneys ;
c. Renal arteries ;
d. Ureters ;
e. Urinary bladder ;
f. Commencement of urethra.

waste products and water from the blood stream. The excretion called urine is carried away by ureters, one from each kidney, and enters the bladder where it is stored and is discharged through the urethra outside the body from time to time.

In the ox the kidneys are lobulated, each having 20 to 25 lobes or rounded extremities. The right

kidney lies below the last rib and the left occupies a variable position. It is usually on the left, but when the rumen is full it pushes the left kidney to the right side, a little below and behind the right organ.

The inner edge of the kidney is concave. The concavity at the middle of the inner edge is called **hilus.** The arteries enter the kidneys from the aorta and the return blood goes to the inferior vena cava. The ureters are narrow, whitish tubes. The bladder is the bag to hold the accumulated urine. It can distend on receiving urine. Urethra is a tube which carries away the urine from the bladder. The mouth of the urethra is closed by a sphincter muscle. The bladder ejects urine through the urethra.

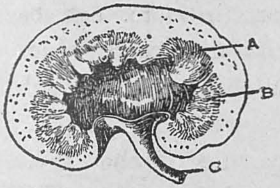


Fig. 82.
Section of the human kidney.
A. Capsule ;
B. Pelvis of kidney ;
C. Ureter.

There is a funnel-shaped cavity in the kidneys called pelvis of the kidney. There are projections in the cavity called **pyramids,** the surface of which is filled with minute holes. They are the openings of the tubules of which the substance of the kidney is composed. The outer side of the kidney is called **cortex** and the portion next to it is called medulla.

Blood enters the kidneys directly from the aorta under great pressure and passes into the tuft of the capillaries called **glomeruli,** enclosed within the

capsule. Here water oozes through these capsules and passes into the tubules. As water passes down, the tubules, poisonous waste materials from the blood, are added to it by the activity of the renal cells.

This stream of water enriched with soluble solids and the urea of the blood reaches the pelvis of the kidney. From the lower end of this chamber urine is conveyed through the ureter to the bladder.

Urine and perspiration are to a certain extent inter-dependent in most animals. Most poisons taken into the body are eliminated from the system with urine. Quinine, morphine etc. can be traced in the urine. In bacterial diseases, poisons produced by the bacteria are also eliminated through the kidneys.

The specific gravity of the urine of the ox is between 1006 and 1030, the average being 1020. The urine of the herbivora is usually alkaline and that of the flesh-eating animal is slightly acid.

The quantity of urine excreted in 24 hours depends upon the size and the breed of the animal and also upon the diet and the quantity of the water drunk. Usually the ox excretes between 10 to 40 pints, the average being 22 pints.

The urine of the ox is yellow in colour and has got an aromatic odour. Many abnormal substances are sometimes excreted with the urine, including sugar, blood and pus in the diseased condition of the animal.

The kidneys act as chemical filters to the blood, separating the excess of water and also urea etc. from

the blood. But the whole of the blood is not purified by passage through the kidneys before it is forced through the arteries of the heart. After purification from the lungs blood is forced into the arteries for service to the body. A portion only of the blood so forced passes through the kidneys and gets purified. This is only a fractional purification of the blood. But as this fractional work is going on continuously, there is a limit which the waste products cannot exceed in the blood. Blood is taken at great pressure to the kidneys from the heart and the pressure is a very large factor in the normal working of the kidney. If there is sudden high blood pressure a large amount of blood will pass through the kidney producing a large quantity of urine to be excreted. If the heart be working feebly then the kidney filters are not able properly to work, and, therefore, there will be less elimination of waste products which will increase the toxicity of the blood. When the kidneys begin to fail, water or serum begins to accumulate in the system giving rise to the condition known as dropsy.

When large quantities of proteins are taken, proportionately larger quantities of the broken-up products or urea has to be handled by the kidneys. The quantity of urea is increased. It is formed during the digestion of proteins. The more unnecessary protein is taken into the system the more unnecessary work it means for the kidneys. And the kidneys under such circumstances may be over-taxed leading to various kidney diseases.

1287. THE SKIN.

The skin is a secretory or excretory organ, through the pores of which waste products from the blood are secreted out. The skin allows carbon dioxide gas to escape and it takes in oxygen. In this way it performs in some ways the functions of the lung.

The skin consists of two parts, **epidermis** or the outer layer and **dermis** the inner layer or the true skin.

Epidermis or **cuticle** consists of many layers of cells. The dermis or **corium**, on which the epidermis rests, consists of a fine, strong net-work of connective tissues.

The epidermis can be divided into two layers, the outer hard layer or **corneous layer** and the deeper soft layer. The two layers get separated when there is a blister. The lower layer of the dermis contains pigment, giving the characteristic colour to the skin.

There are the fat-containing tissues just under the skin, and the deeper part of the dermis is connected through this intermediate layer of tissues to the muscle or bone. The fat-containing tissues give the rounded appearance to the limbs. This layer is particularly thick under the abdomen. The dermis is supplied with blood vessels but the epidermis is not. These blood vessels form loops of capillaries just underneath the epidermis. The dermis is well supplied with nerves.

The skin is full of pores. These are the openings of **sweat glands**. The pore is the end of a spiral, cork-screw-like tube which passes through the

epidermis to the dermis. Here the tube wall thins down to a single layer of cuticle cells. Further below, this tube coils into a knot. The coiled part is the sweat gland. The cells of sweat glands secrete from the blood **sweat,** which is then conducted along the tube to be discharged on the surface of the skin.

In the dermis, there are situated the **sebaceous** or **fatty glands.** They are always connected with hairs. These glands have short ducts leading to small sacks filled with cells. The ducts open into depressions of the skin in which the hairs lie. The secretion is fatty.

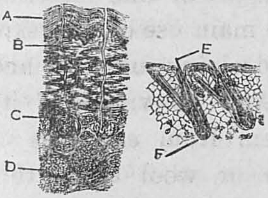


Fig. 83. Section of the skin, showing sweat glands, hairs.
A. Epidermis ;
B. Dermis ;
C. Sweat glands ;
D. Fat ;
E. Hair ;
F. Hair root.

When **perspiration** is secreted in a small quantity it is spontaneously evaporated and is called **insensible perspiration,** because it is not evident to the senses.

In hot weather and during exercise perspiration is poured out faster than it can evaporate and then it is called **sensible perspiration.** When perspiration evaporates, it takes a way heat from the skin. In this way a large quantity of heat is taken away from the body.

Hairs : The body of the ox and other domesticated animals is covered with hair. The hairs are not permanent. They are shed and are replaced. Normal shedding occurs twice a year. The hair coat is thick

in winter and the hairs begin to shed with the arrival of hot weather.

In addition to hair the skin possesses the appendages of horns, hoofs, claws, nails etc. These are closely packed epidermal cells which have undergone a process of what is called keratinisation. They may be compared to hair matted together into a mass. They are formed from a specialised form of dermis called **matrix.** The hollow horns are of this material.

Functions of the skin : The main use of the skin is protective. It covers the underlying muscles and protects them from injury. And in virtue of its padding of fat, it protects them from extremes of temperature. The hairs or fur or wool assist this heat regulation. When cattle are kept out of doors in the winter they grow a long, thick coat of hair, which they do not, if kept in warm byres. The hair roots, having a fat reserve, serve to make their surroundings water-proof.

Heat regulation is one of the most important functions of the skin. The ox is an warm-blooded animal. In warm-blooded animals the temperature of the blood remains constant whatever be the temperature of the surroundings. In order to maintain evenness of temperature, the body must have mechanism to keep it warm when the surroundings are cold, and to keep it cool when the surroundings are warmer than the blood.

Heat in the body is created by the action of the voluntary and the involuntary muscles each time they contract. When cold air or water comes in contact

with a large surface of skin, the numerous blood vessels of the skin immediately contract, reducing the amount of blood which would have been cooled by exposure from outside. When the surrounding medium is warmer than the temperature of the blood, the blood vessels of the skin dilate, more blood is brought to the surface which induces sweating, and when the perspiration evaporates it exerts a cooling action. This brings down the temperature of the surface of the skin. Even when there is no sweating, the extra amount of blood circulating near the surface gives up heat and thereby helps to keep its temperature normal. These contracting and dilating actions of the blood vessels are controlled automatically by what is known as reflex action.

The skin does some portion of the work done by the lungs by discharging waste materials like carbon dioxide through its pores. Certain lower animals, such as the frog, expire as much waste materials by the skin as by the lungs and can exist by skin respiration alone. Gaseous exchange takes place exactly as in the lungs, oxygen is absorbed and carbon dioxide is thrown out. In the ox and other animals something like this also takes place. But the work done by the skin is incomparably small. It is believed that the characteristic odour of an animal is due to the organic matter thrown out by the skin.

The skin of the ox, therefore, requires to be kept in a clean condition. Baths daily or on alternate days are necessary to keep their skin clean. In the barns where they are kept, urine and fæces usually soil

their skin and the cattle feel as uncomfortable as any other animal when excreta remains on the skin. By washing off and rubbing, the skin is kept clean and healthy, and a little rub during the wash is invigorating.

1288. THE NERVOUS SYSTEM.

The nerves are glistening, white strands of fibres in the body, distributed throughout like the arteries, veins and the capillaries of the circulatory system. While the centre of the circulatory system is the heart, the centre of the nervous system is the brain. The nerves are soft to the touch and each thread of nerve is like a tiny glass tube filled with oil. Several of these nerves run side by side or are intertwined to form a single composite cable-like thing.

The function of the nerve is to carry report to its head quarters, the brain, and carry back orders from the brain. Sometimes there are points in the spinal cord which act like head quarters and give orders for actions without waiting for the message to travel past it to the brain and get an order.

The speed with which the nerves carry the message is slow, being 100 to 200 feet per second. This speed is enough for all ordinary purposes. When, however, a habit is formed, the process of transmission and receipt of message is much simplified and is mechanically and almost automatically done.

When a cow starts off from home in a new track she has to feel the road and surroundings, she has to

proceed cautiously, noting that here is a ditch, there is an elevation, here a steep ascent or descent or a dangerous curve. But when she passes often in the same order, her senses get used to it, and she can travel on almost automatically, without having to think and feel.

There are certain functions of the body which the nerves perform without the guidance of the will. Walking, seeing, working requires the guidance of the will from the brain, but the functions of breathing, respiration, digestion, perspiration etc. are performed

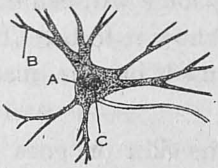


Fig. 84. Nerve cell.

A. Nucleus ;
B. Branched process ;
C. Unbranched process.

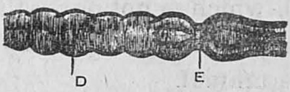


Fig. 85.
Nerve structure.

D. Medulla ;
E. Node.

without the use of the will of the individual. It is the same in human beings and in animals.

These automatic functioning by the nerves is called **reflex action.** Message to and fro for these reflex actions are conducted from centres of the brain. When some food is taken into the mouth, and after mastication it is desired to be swallowed, the tongue pushes it into the gullet. After that, the bolus makes its way into the stomach by the automatic muscular movements of the œsophagus. In the rumen it is automatically moved about, and when after the wilful

work of rumination the food materials go to the stomach, the automatic reflex action continues. The mouth of the pylorus is automatically closed and opened in proper times, the secretory organs secrete and the whole process of digestion and absorption continues automatically. But no mere automaton can do this. There is intelligence operating every moment. When there is more sugar in the blood, the liver stores it by converting it into a solid form and as soon as there are demands for sugar in the blood, the liver commences to supply it in appropriate doses. So, there is some will behind our will which is not our will as we know it to be. These operations are certainly performed by the man or the animal.

When a foreign body enters the skin or goes deep into the muscle and remains there, the machinery of the body is brought to operation to throw it out. Inflammation occurs, blood sends leucocytes to expel or absorb it. The leucocytes die in the fight and pus forms. They would come possibly to the surface, throw out the foreign body and the pus, and the healing process continues. These are performed unerringly in a much better way than any surgeon could possibly direct.

The involuntary functions are more important than our voluntary ones ; for, life would be impossible for a minute if the involuntary control over the body was not exercised.

This involuntary controlling agency keeps the muscles of the arterial tubes in a state of controlled

constriction, so that the regulated quantity of blood may flow through them at a certain pressure.

If this control is withdrawn, the arteries will get relaxed, offering little resistance to the blood, which will then flow into those parts where it can flow without pressure, leaving the important organs of the brain, liver, kidneys etc. without a sufficient supply of blood to function, resulting in death.

The nervous system consists of the brain, the spinal cord and the nerves proceeding from them. The brain and the spinal cord form the **central nervous system.**

A **nerve strand** has many fibres, and each nerve fibre has a central core called **axis cylinder.** The casing around is a **medullary sheath**. Then comes the the **neurolemma** or primitive nerve sheath. The neurolemma is continuous throughout, but the next covering—the medullary sheath—is broken in continuity at certain places called **nodes.**

In some nerves there is no medullary sheath but only the neurolemma on the axis cylinder. These are called non-medullated nerve fibres. They are grey, while the medullated fibres are white.

There are two classes of nerves. Those that carry impulses to the centre are called 'afferent' and the other class carrying impulses from the centre is called 'efferent'. These are the nerves which carry the order to the parts concerned. They are also called **motor nerves** while the afferent nerves are called the **sensory nerves.** The **ganglion cells** are situated in the nerves near their origin in the central nervous system or near the endings in the various organs.

The nerve cells contain a large round nucleus. The cells give off processes, and one of these is a strand which becomes continuous with the axis cylinder of a nerve fibre. The axis cylinder may be looked upon as the lengthening of a nerve cell. The brain and the spinal cord are made up of medullated nerve fibres, nerve cells or ganglia together with some supporting tissues.

1289. THE SPINAL CORD.

The **spinal cord** passes through the bony cavity of the spinal column or the vertebræ. The bony cavity of the vertebræ as well of the skull is lined with a lining which is called **dura mater.** It is rough on the surface presented to the bone and smooth in the interior. Then the brain and the spinal cord are encased in a delicate membrane called the **pia mater** which is rich in blood vessels. Between pia mater and dura mater there is a space containing a fluid called the **cerebrospinal fluid.**

The spinal cord extends from the brain case to the joint between the 5th and the 6th lumbar vertebræ. The cord is a round structure, divided into two portions by two grooves called the **anterior** and the **posterior fissures.** These two fissures extend so deeply as almost to meet, leaving a small connecting link, called the central canal.

The cord is of a white substance outside and grey substance inside, in each half. The grey matter is in the shape of a crescent having two horns, the anterior and **posterior horns.** The white matter lies

all round the crescent of the grey matter, and the two halves are connected by the grey matter.

The **spinal nerves** are thrown out from the spinal cord at intervals along its length. Each single strand contains nerves from the anterior and the posterior roots which are united to form a nerve trunk. Before joining to form a trunk the posterior root contains a knot-like enlargement or the **ganglion**.

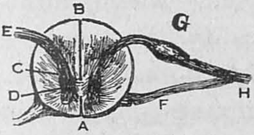


Fig. 86.
Cross section of the spinal cord.

A. Anterior fissure ; B. Posterior fissure ; C. White matter; D. Grey matter ; E. Posterior root ; F. Anterior root ; G. Ganglion on posterior root ; H. Trunk of a spinal nerve.

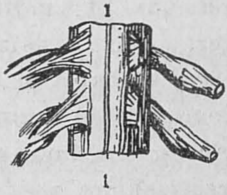


Fig. 87.

Front view of the spinal cord, showing anterior and posterior roots.

As the nerve trunk is traced back to the spinal cord it is found that at the junction of the two roots the motor and the sensory nerves are sorted out. All the sensory nerves pass by the posterior root and all the motor nerves by the anterior root. These roots are, therefore, called **sensory** and **motor roots.**

When the posterior root of a spinal nerve is injured, the part to which the nerve goes becomes senseless, but if the anterior root is uninjured the part can be moved. If the reverse happens,

then sensation can be felt but the part cannot be moved.

1290. THE SENSATIONS.

There is something very striking about the sensory nerves. Sensation in man is popularly supposed to be derived through the fine senses. But in addition to these, impulses are carried by special nerve fibres and are converted into sensations which furnish impressions of movement, locality, proximity to danger, a sense of pain, a sense of heat and cold ; and it is very probable that in wild animals specially, and in domesticated animals to a great extent, these secondary sensations and the apparatus by which they are received are very much more acute and highly organised than in man. What is commonly spoken of as instinct may ultimately prove to be a greater power of appreciation of external conditions rather than an inborn hereditary something which advises an animal to perform and not to perform certain things. A newly-born kitten is blind. But immediately it is born, it tries to stretch and operate its legs in a blind, ugly but certain manner to move towards the abdomen of its mother and on reaching it, it immediately seeks out a teat and puts itself to it, without any aid from the mother. If several of these are born at a time they struggle for the same objective, jostling, pushing one another till each one gets on to a teat for sucking. This sort of action can be dimly explained by the power of the animal of receiving extra-sensual impressions.

1291. THE REFLEX ACTION.

If a man's spinal cord is injured somewhere above the sacral region then the impulses cannot pass to and fro between the brain and the lower parts. Now, if his feet is pricked, his legs will be suddenly drawn up although he cannot feel the prick or cannot of his own will draw up his legs. His sensory and motor nerves being cut off from the brain he can neither

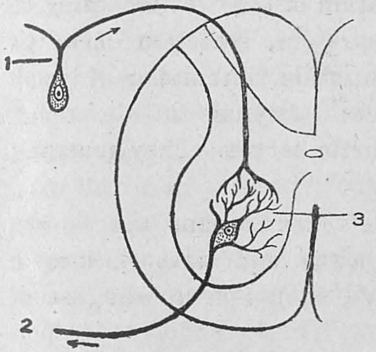


Fig. 88. The reflex arc of the spinal cord.

1. Sensory nerve fibre afferent. 2. Motor nerve fibre efferent; 3. Nerve cell.

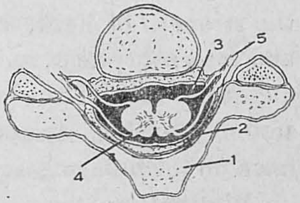


Fig. 89.
A section through the spine.

1. Spine of vertebra; 2. Meninges; 3. Spinal fluid; 4. Spinal cord; 5. Sensory and motor nerve trunk.

move nor feel any sensation of the lower limbs. Still, on a prick he draws away his legs. This action is explained as a **reflex action** which does not need the dictation of the brain for its performance. The prick causes the sensation to pass through to the spinal cord. These impulses act on the grey matter of the cord in such a way that they cause new motor impulses to arise. These impulses pass from the

grey matter of the anterior horn to the nerves of the muscles of the leg, and then the muscles contract.

A movement produced by the spinal cord or the brain without volition or action of the will is called reflex action. The spinal cord in this way forms sub-stations for governing the body apart from the brain itself. Some of the involuntary or reflex acts are :

Contraction and dilatation of the eyes according to the strength of light, respiration, secretion of saliva and internal juices, perspiration, circulation of blood, digestion etc. The nerves carrying out the reflex actions are called **sympathetic nerves.** They generally have no medullary coating.

We shall analyse some reflex actions apart from those happening automatically and in a clock-work manner in the body. We shall take up the case of response to stimulus.

Take, for example, the fore-limb of the horse. Imagine the part smartly struck with a light stick. Almost before the stick has left the spot, the horse has snatched up its foot and replaced it. Sometimes the event happens so quickly and suddenly and without the knowledge of the animal that it is startled not by the stroke from the stick but by the fact that it has moved its foot.

Here the spinal cord has carried out a definite action without any assistance or control by the brain. Reflex action is much more highly developed in animals than it is in man. The movements of wild animals, quick as lightning, become only possible

by virtue of reflex action. The movements of man are slow and very deliberate when compared with the swift suddennees of the falcon hawk swooping to strike at its prey or to the speed of the lion making for its game at the rate of 60 miles per hour.

1292. THE BRAIN.

The brain in the ox is composed of three parts, the fore-brain, or the **cerebrum,** the mid brain and the hind-brain or the **cerebellum.** The fore-brain is divided into two hemispheres. It comprises most part of the brain and also controls the activities of the rest. The mid-brain is formed by peduncles. It is a short stack that connects the fore and the hind parts. The hind-brain or the cerebellum is formed by the hemispheres which lie in the most posterior part of the bony cavity and also of the pons and the medulla. The pons acts as a bridge which connects the various parts of the brain together. The medulla is the direct continuation of the spinal cord. In it are located the centres that control the actions of the heart, respiration, circulation, and the actions of the digestive system from the mouth to the large intestine. It is the path through which the nerves of the brain pass in and out of the brain. It gives rise to all the cranial nerves except those of smell, sight and the muscles of the eye balls.

The brains are composed of grey and white matter, the grey matter being on the surface, although some grey is embedded in the white matter. The white matter is made up of a large number of nerve fibres,

each of which is connected with a cell in the grey matter arranged in various paths. These paths are either efferent or afferent.

The brain varies very much in different animals. The proportional weight of the brain compared to body-weight in different animals is given below :

Cat	...	1 to 99
Dog	...	1 to 235
Horse	...	1 to 593
Ox	...	1 to 682

Intelligence does not depend entirely on the weight of the brain but on the proportion of grey and white matter.

The cerebrum itself is non-sensitive. It can be handled, cut or injured without a sense of pain in the subject. The cerebrum is concerned with the higher senses such as memory, initiative, volition, intelligence, and it is the receiving point of the impulses that originate from the special sense organs—those of sight, smell, taste, hearing and touch.

The main function of the cerebellum is to co-ordinate muscular movements, to preserve the body balance and with the assistance of visual centres to govern the direction of the responses.

1293. THE CRANIAL NERVES.

The nerves which leave the surface of the brain are 12 in number, the same as in men.

1. Olfactory nerves or nerves of smell.
2. Optic nerve or nerve of sight.

3, 4, 5. Motor nerves for eye balls.

6. Trigeminal nerve for sensation of the face, movement of the jaw and the tongue.

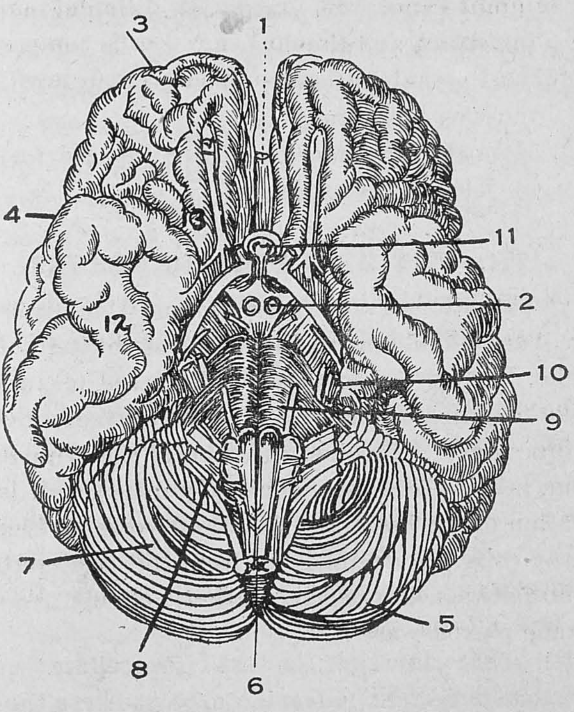


Fig. 90. The base of the brain.

1. Corpus callosum ; 2. Corpora mamilaria ; 3, 13. Frontal lobe ; 4, 12. Temporal lobe ; 5, 7. Cerebellum ; 6. Medulla oblongata , 8, 9, 10, 11, 14. Cranial nerves.

7. Facial or motor nerve for the face and mouth.

8. Auditory nerve for hearing.

9. Glossopharyngeal nerve, being the nerve of taste.

10. Vagus nerve, partly motor and partly sensory. It passes down the neck to the thorax and abdomen controlling the heart, the larynx, the lungs and the stomach, including the intestines and the liver.
11. The spinal accessory nerve going to certain muscles of the neck.
12. Hypoglossal nerve, motor nerve for the muscles of the tongue.

1294. THE SYMPATHETIC NERVES.

Sympathetic nerves form a system which is beyond our will and the main centre of it is at the top of the medulla. Along the spinal cord there are plexuses or net-works of nerve fibres which control many involuntary functions. The chief function of the sympathetic system, besides some others already mentioned, is the regulation of the heart and the blood vessels. Plexuses or net-works are formed in front of the vertebral column between the two sympathetic chains.

Some plexuses are :—

1. Cardiac plexus ;
2. Solar or epigastric plexus ;
3. Pelvic or hypo-gastric plexus.

The **cardiac plexus** is a net-work of nerve fibres formed by the sympathetic and the vagus or the 10th cranial nerves. From the heart, the muscles receive their nerve supply. The **vagus** carries the inhibitory impulses to the heart and the **sympathetic** carries the opposite or accelerating impulses. When the vagus

nerve is cut off and its restraining influence is withdrawn, the heart beats at a very quick rate. If, however, the vagus centre is stimulated, there is more restraint on the speed of the heart which slows down. When the sympathetic nerves are cut off, the heart beats slower and slower and when they are excited the heart beats faster and faster.

The Vasomotor System : The vasomotor centre is situated in the medulla. The impulses from the vasomotor nerves keep the muscular coating of the arteries in a state of constriction through the vasomotor nerves. Without this control the arteries would dilate and reduce the blood pressure, and thereby fail to serve those organs with blood which require higher pressure. The effect of such poor circulation will be first felt in the brain where a maximum pressure of blood is necessay and will bring about unconsciousness.

The controlling action of the vasomotor nerves is necessary every moment. During digestion shortly after meals, more blood is necessary in the digestive organs. For this purpose the vasomotor nerves induce relaxation of the arteries of the abdomen; blood flows there more and is withdrawn from other parts, such as skin. The skin loses warmth. This accounts for the sensation of chill after a meal. When the temperature of the body is to be reduced the vasomotor nerves cause more blood to circulate through the skin, where some more heat is lost by radiation. On the contrary, when the body heat is to be conserved the vasomotor nerves make the supplying arteries to the

skin constrict, so that there is less flow of blood on the surface and there is less cooling down.

The arteries carrying blood to the brain, to the heart and to the lungs are without the control of the vasomotor nerves. These nerves do not serve these organs. So that when there is rise of blood pressure in the system on any account, the blood rushes to the brain, and there is a feeling of headache. On the contrary, when other organs take more blood by relaxation of the arteries of those organs, then there is less blood supply to the brain.

1295. THE EYE AND VISION.

The general arrangement and construction of the eye in the ox is the same as in the horse or in man.

The eye is set in a bony cavity called the orbit. The eye ball is an organ sensitive to light and is suspended in its cavity. The cavity protects the ball on all sides except at the front where it is guarded by the eye-lids. The eye-lid is attached behind by the optic nerve, and six striated muscles connect the eye ball with the wall of the cavity or orbit. Four of these muscles are straight or **recti muscles**. There are two slanting muscles—the superior and the inferior oblique muscles. With the help of these six muscles, the eye can be directed or rotated to any direction. The movement of the eye ball must be a complicated one but the six muscles can direct it at any angle in any direction.

The eye ball has three coatings. The outer coating is of the **cornea**, which is in front of the eye. Behind

the eye lining the cavity, this coating is continued and is called the **sclerotic coat.** The middle coating has three names : behind, it is called (a) the **choroid coat** and is super-imposed over the sclerotic coat. At the edge of the cornea this coat separates from it and projects out to form (b) the **ciliary body** or the hairy coat, and just behind the cornea it is projected as a circular screen called (c) the **iris** in front of the lens.

The middle coat is a vascular, pigmented coat, having a black lining. Within the iris there is an

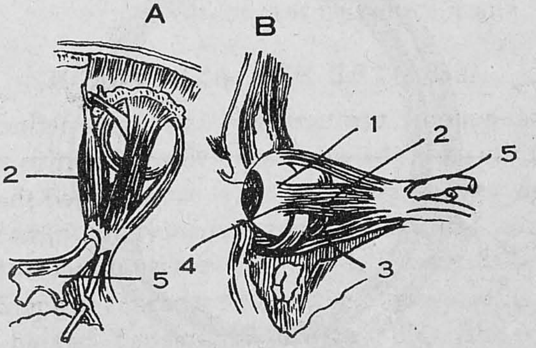


Fig. 91. A-B. The muscles of the eyeball.
1. Eyeball ; 2. Superior oblique ; 3. Rectus inferior ; 4. Rectus lateralis ; 5. Optic nerve.

aperture called the **pupil.** The last or inner coating is called the **retina.**

The top coating of the cornea and the sclera is of firm, dense fibrous tissue and elastic fibre which form the white, hard covering for the eye. To this coat are attached the various muscles which move the ball. In front, this coating loses its white colour and becomes transparent so that the black pigmented middle coating

can be seen through it. This transparent portion is called the cornea. Before the choroid or middle coat becomes continuous with the iris, it is thrown into a number of folds arranged in a radiating manner all round. These folds are the **ciliary processes.** The folds are also covered with a layer of pigment.

The iris is like the diaphragm of a camera and the pupil is like the aperture of the diaphragm. The size

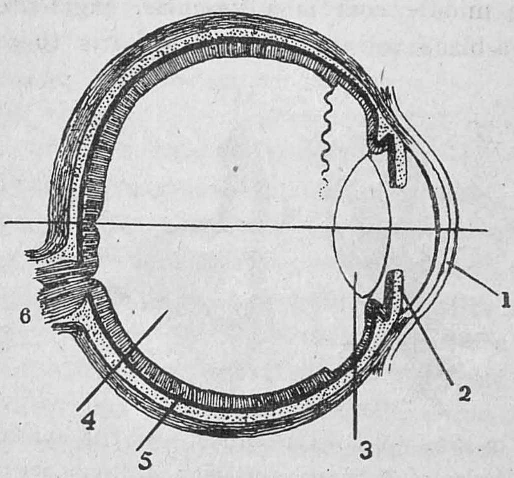


Fig. 92. The eyeball.
1. Cornea ; 2. Iris ; 3. Lens ; 4. Vitreous humour ; 5. Retina ; 6. Optic nerve.

of the pupil is variable and can be regulated by the muscles of the iris or the diaphragm. In shade the pupil enlarges, taking in more light in the eye through the enlarged aperture ; in the direct light of the sun the pupil contracts to a pin-hole so as to shut out all unnecessary light. In the ox the cornea is oval and

the pupil is roughly oval or even egg-shaped with the larger end inwards. The colour of the iris is either a warm chocolate brown or greyish blue, very dark or almost black, or else appears to be variegated with patches of white.

As we look at the eye from the outside we find that the lids protect it. The lids are composed of dense fibrous connective tissues with a lining of thin delicate membranes called the **conjunctiva.** They terminate in hairs called eye-lashes. There are glands at the roots of these hairs. Inflammation of these glands is known as the **stye.**

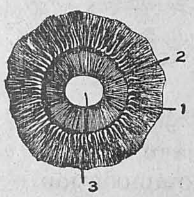


Fig. 93. Iris.
1. Ciliary processes; 2. Iris; 3. Pupil.

The eye ball is embedded in the socket having a padding of fat behind. In disease this store of fat may be gone, then the eye looks sunken.

The eye requires constant washing or moistening. For this purpose, nature has provided tear glands or lacrimal glands at the outside top corner of the eyes. The water from this gland moistens the eye and the excess passes down to the lacrimal duct starting from the corner of the eye nearest to the nose. The duct carries the excess water to the nose, the lacrimal duct being the main pipe of gland emptying into the nose. When excessive tears appear on account of emotion or shock, the drops of tear over-flow the eye and run down the cheek.

The cornea is a projecting, transparent and almost circular portion of the eye. The space between the

cornea and the iris is filled with a thin watery fluid called **aqueous humour.**

Behind the iris comes the **crystalline lens.** It is a transparent glass-like lens composed of jelly-like substance placed in layers like those of onions. The lens is suspended from the ciliary body by ligaments. Behind the lens the large cavity of the eye-ball is filled with a matter called **vitreous humour.** At the back, behind the lens, is the retina which is the sensitive portion of the eye. The retina is almost entirely composed of the nerve terminations of the optic nerve.

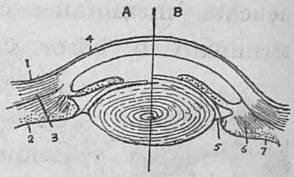


Fig. 94. The changes in the lens in accommodation.

A. Adjusted for distant objects; B. Adjusted for near objects.

1. Conjunctiva; 2. Choroid, 3. Sclera; 4. Cornea; 5. Suspensory ligament; 6. Ciliary muscle; 7. Ciliary process.

In the act of seeing, the rays of light falling on the eye pass through the transparent portion of the cornea, and penetrating the aqueous humour, enter the lens through the aperture of the pupil. The pupil cuts off side rays in order to give a clear image. The aperture is also regulated by the amount of light needed. Light from the object then enters the lens, and passing out of it, strikes the retina. The lens is bi-convex and the image formed on the retina is a reversed image of the object. But this reversed image is no bar to our seeing the object upright as the actual seeing is done by the brain which corrects the inverted visual impression to an upright one.

The lens like all ordinary lenses forms the image of the object at its focus. The place where the image is formed behind the lens depends upon the distance of the object and also upon the curvature of the lens. In the case of the eye we have got the place of the image fixed at a definite point. The image must fall on the retina. In order to accomplish this, the curvature of the lens is varied by means of the ligament attached to the lens. For distant objects the lens becomes flat ; for nearer objects the lens becomes more convex.

The power of the lens to adapt its curvature according to the distance of the object is called **accommodation.** The lens is elastic. If its surface is made flatter by pressure, it recovers its original curvature and shape when the pressure is relieved. The lens is enclosed in a transparent capsule of membrane which is attached to the suspensory ligaments connected with the ciliary processes. The ligament is naturally tight and keeps the lens normally under pressure and, therefore, less convex than if the pressure were removed. By contraction of ciliary muscles, the ligaments are slackened and the lens by its own elasticity becomes more convex. This happens when we are looking at a near object.

It is difficult to see objects nearer than 5 or 6 inches from the eye, for the lens cannot be made convex enough to bring the image on the retina. Short-sighted persons cannot see distant objects clearly because the flatness of the lens is not enough or in other words, the image strives to form past the retina.

In order to bring the image on the retina the lens of the eye has to be flattened more. This is accomplished by putting concave spectacles before the eyes. Similarly, old people who are long sighted cannot see near objects clearly. The defect is remedied by adding to the curvature of the lens of the eye by wearing convex spectacles.

The qualities of perception of outside objects by the eyes of the animal are not well-known to us. For, it is not possible to communicate with the animal on this matter and compare and explain the difference. It appears, however, that in soaring birds, such as the hawk or the vulture, most acuteness of vision is provided. The carnivorus animals have the next most acuteness of vision, the herbivorous animals have the least visual acuteness. These latter can utilise more of their powers of hearing, and of smell.

In certain animals the eyes are placed sidewise in the head. They cannot see an object directly in front of them with both their eyes at the same time. One eye has to be focussed on the object, while the other eye sees quite a different picture. This is called monocular vision. When the eyes are placed on the front of the head as in man, each eye sees a slightly different picture, but the two visions overlap. This is called binocular or stereoscopic vision. This super-imposition gives an idea of the distance of the object. The horse or the ox probably possess the power of using both monocular and binocular vision, according to circumstances. When the attention of such an animal is brought to bear

on a subject in front of it, the two eyes are turned slightly inwards in a squint, each ear is pricked, particularly in the horse and the dog, and it sees the object with both the eyes. When, however, it casually sees an object at the side or behind it, one eye only is employed. The head is slightly inclined towards the object, the corresponding ear is usually pricked, and the animal uses monocular vision only.

It is peculiar in animals that although their eyesight may be highly developed, yet they seldom trust their eyes in matters of emergency. The visual images alone do not convey the impression required by the animal. It becomes necessary that the animal shall verify his visual impression by lactile or olfactory impressions, by touch or smell. The fear of a new harmless object may be dispelled by allowing the animal to smell it or touch it with its nose.

1296. THE TONGUE.

The tongue is a muscular or fibrous organ rich in blood vessels and nerves and covered with a highly specialised mucous membrane. It consists of a tip and a middle part or the body and the root. The tongue of the horse has a blunt tip, (Fig. 95), but that of the ox has a short, tapered or conical tip. The mobility of the tongue of the ox is less than that of the horse. The tongue of the ox has a dorsum or a hump-like eminence divided from the lip by a distinct transverse groove. The dorsum is of great service in swallowing and also in bringing forward the balls of cud from the back of the mouth for chewing with the molar

teeth. The dorsum is small in the sheep and the goat. A pair of bones, the hyoid, support the root of the tongue in the larynx.

Over the surface of the upper part of the tongue there are the papillæ, which are small protuberances. There are three kinds, the filiform, the fungiform and the circumvallate papillæ. The **filiform** are fine, thread-like projections spread all over the tongue. The filiform papillæ carry the sense of touch and are coarse and sharp-pointed in the ox, which become horny in the carnivorous. The **fungiform** papillæ are larger than the filiform. They are chiefly situated at the tip and the sides of the tongue. They carry the sense of taste. They are mushroom-shaped. The **vallate** papillæ are in number between 20 and 30 in the ox. They are found far back on either side of the middle line. They are situated each in a little depression into which the taste-buds open.

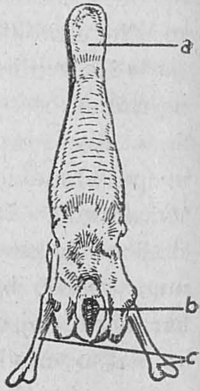


Fig. 95.
The tongue of the Horse.
a. Tip ; b. The opening into the larynx ; c. The two branches of the hyoid bone.

The tongue is used to control the food in mastication. It is a delicate sensory organ possessing both the senses of touch and taste. It plays a certain part in the production of sound. It has a prehensile use in the ox in gathering the food before it is cut into bits by the lower incisor teeth and the dental pad.

In the ox the tongue is often used for cleaning its nostrils. It is also used for toilet purposes, to lick over the greater part of the body. The tongue is of great service in removing the slough-like coat from the new-born ones. Cows with their tongue clean and dry their coat. Animals have the habit of licking their wounds. There is no curative virtue in licking —it only helps to remove the coat of dirt and pus. Licking often obstructs the healing of wounds in domesticated animals by keeping up the irritation.

1297. THE TEETH.

The teeth are hard, white or yellowish-white organs, implanted in their sockets or alveoli in the upper and lower jaws. They serve to secure the food and bite and chew it. In the carnivorous animals they are also used as weapons of offence and defence, but in the ox they are seldom used as such, although there are cows which attempt to and occasionally do bite their attendants. The teeth are divided in the ox into two main classes, the **incisors** and the **molars.** There is a third class, the **canines,** which are in a rudimentary stage in the ox, being similar to the incisors, although slightly different from them.

The ox has no incisors in the upper jaw, which has a dental pad to present to the incisor teeth of the lower jaw.

The molars are situated further back in the mouth, and between the incisors and the molars there is a large gap in the jaw-bone not covered by any teeth.

Each tooth has a crown which is the top portion covered with **enamel**. The root is the portion that lies in the socket. Between the socket and the teeth there is cement that binds the teeth to the socket. In the incisors of the ox there is a constriction called **neck,** where the crown and the root meet. The molars have no neck. The top covering of the tooth consists of enamel, and the tooth material is called the **dentine.** It is hollow inside and is filled with a substance called **tooth-pulp** which is a mass of nerves and blood vessels.

The tooth in animals give much valuable indication as to their age, and therefore, require study and observation. Such estimation of age is reasonably reliable but is not accurate scientifically, as it varies with breed and also in individuals of the same breed. Artificial methods of management, forced feeding upon concentrated food stuff, and selection of types, affect the period of the eruption of the teeth, so that very considerable variations may be found between a hill-type of cow and well-recognised and cared-for breeds :

In the ox, the calves have first the milk teeth, and after a time these begin to fall off and simultaneously permanent teeth make their appearance. The temporary or the milk teeth of the ox are as under.

	Incisors.	Molars.
Upper jaw ...	0	6
Lower jaw ...	8	6

The permanent teeth are as follows :

		Incisors.	Molars.
Upper jaw	...	0	12
Lower jaw	...	8	12

The upper jaw is devoid of teeth. There is only a dental pad which is a hard dense mass of fibrous tissue against which the 8 lower incisor teeth bite.

The incisor teeth are loosely embedded in the jaw, normally allowing slight movement. They have a spade-shaped crown and a constricted neck. The temporary incisors are small and brittle, and there will be no difficulty in distinguishing them from the permanent incisors.

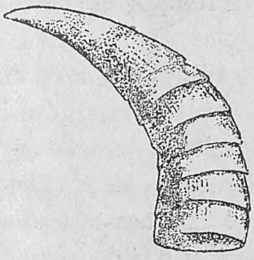


Fig. 96.
Age indicated by the rings in the horn.

The molars in the ox progressively increase in size from first to last. The first is quite small and the length occupied by the first three is only about half of that occupied by the last three.

The eruption of teeth occurs at almost definite periods. The age, however, is determined by the incisors, and the time of their eruption is more important than that of the molars.

Age may also be calculated from the rings in the horns, every year a new ring is added, beginning from the third year. So that the number of rings plus two gives the age of the animal. But often the rings are not pronounced and are not helpful in determining the age.

1298. INCISOR TEETH.

At birth : 8 milk incisors are palpable below the gum and they all come out clear by the first month. They are crowded together on account of the small space in the jaw.

At the age of a year : The first or central pair of milk teeth show much wearing down, while the second pair, one on either side of the central pair, shows also appreciable wearing down. The 3rd and the 4th pairs are only slightly worn.

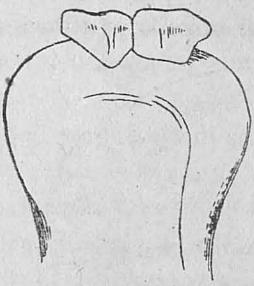
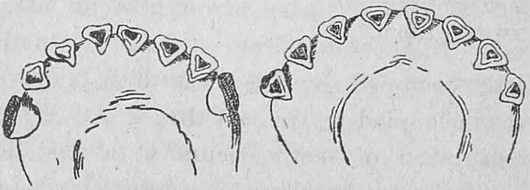


Fig. 97.
Milk incisors at birth.

At the age of 15 months : While the 1st and 2nd pairs are quite worn, the 3rd pair also show considerable wearing down. The fourth pair shows only slight wear and tear. They are now spaced somewhat apart with gaps between one another.



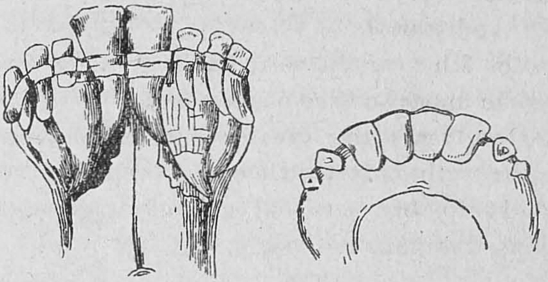
Fifteen months. Eighteen months.

Fig. 98. Milk teeth.

At the age of 18 months : The 8 teeth are spaced further apart, the jaw having developed

more in width. All the 4 pairs show wear and tear.

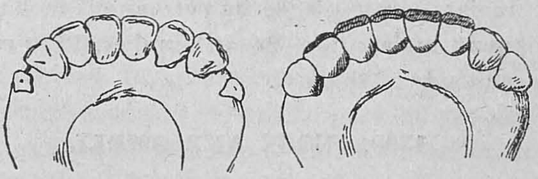
At the age of 2nd year : The first pair of permanent teeth appear, pushing out the milk teeth.



Two years. Three years.

Fig. 99. Milk and permanent teeth.

At the age of 3rd year : The first and second pair of the permanent teeth are out and under wear and tear, while the roots of the 3rd and 4th pairs of milk teeth are still there.



Four years. Five years.

Fig. 100. Milk and permanent teeth.

At the age of 4th year : The third pair of permanent teeth are in their places, while the 4th pair of milk teeth are present in the stump.

At the age of 5th year : All the permanent teeth are out. The first and second pairs are well worn, while there is some wear and tear in the 3rd pair; the fourth pair shows fresh eruption.

Henceforth, age can only be judged by the amount of wear and tear.

In the 7th year the wear and tear show half way across the upper surface of the teeth.

At ten years the greater part of the crown have worn the teeth, only a little enamel remains.

At 14 to 16 years, all enamel is gone, only the cup-shaped stumps remain.

1299. MOLAR TEETH.

The ox develops 12 molars, 6 in each jaw in milk dentition. The molars increase in size progressively from first to last, so that the length of the gum, accommodating the first three, is only half of what was accommodated in the last three. As the milk incisors are replaced by permanent ones, similarly the milk molars are replaced by permanent molars. The permanent molars are 24 in number, 12 in each jaw, 6 on each side of the jaw.

1300. NOSE AND SMELL.

The sense of smell is situated in the nasal membrane and in the nerve centres. The odoriferous substances give out their particles to the air and these on reaching the nasal membrane cause the sense of smell. There are certain substances that act more quickly on certain animals. The carnivora are

attracted by the smell of flesh, blood, offal; while grass, grain and vegetable substances stimulate the sense organs of the herbivora. The odour of flesh and blood is repulsive to the herbivora, and may cause great nervousness and fright. The oxen know a slaughter house from a distance, probably by its smell, and on occasions offer great resistance to being drawn in. Sometimes they defy all attempts to restrain them and break loose and bolt away. Most of the herbivora can locate their enemy, the carnivora, at great distances. A deer can detect a carnivorous animal at its kill, some two miles away, if the wind be favourable.

By this sense of smell the cattle can distinguish the poisonous grasses, and select their food. They know their own keepers by their smell without seeing them and also recognise the odours of their own calves without seeing them. The male is attracted to the female during heat through smell. The female in œstrum throw powerful odoriferous materials which attract the males of the species to them.

Cows recognise the dead skins of their calves and may be deceived into milking by the presence of a stuffed structure clothed with a part of the skin of the dead calf. Smell thus plays a far more important part in the lives of animals than in men.

1301. DUCTLESS GLANDS.

Liver, kidneys etc. are glands with ducts, the secretions of which are poured into their ducts. But there is another variety of glands which do not secrete

into the ducts ; they have no ducts. They are called **ductless glands.** They do produce secretions and their secretions are also conducted into the blood stream, producing effects in distant parts rather than local. There are some glands with ducts which in addition to secretion through those ducts make internal secretions. These internal secreting glands are called **endocrine organs.** These glands to a large extent regulate one's personality. The chief endocrine organs are thyroid, thymus, suprarenal or adrenal, pituitary, pineal and the gonads or the sex glands.

The glands secrete. The secretions, called hormones, are very characteristic. A therapy called **organo-therapy** has been built up which consists of the administration of the extracts of these glands. The adrenals are used to produce adrenalin. Thyroids are used for making dried thyroid, thyroid extract and thyroxin ; para-thyroid gives para-thyroid products ; the pituitary gives pituitary extracts. The ovaries and the genital organs are also used.

Thyroid Gland : It consists of two lobes lying along the neck on either side of the wind pipe near the voice box or the larynx. They contain a gelatinous substance having a high percentage of iodine.

It is an energy-producing gland. It brings about the growth of the body and helps to increase the activity of certain cells of the eyes, skin, hair, nail, teeth etc. The thyroid is responsible for the normal growth and development of the animal. If the glands fail to secrete, then physical and normal growth is

stunted. The secretion of the thyroid has also anti-toxic properties and ensures resistance against the onset of diseases due to bacterial attacks. The thyroid glands have been proved to regulate mental activity, body temperature and the respiratory process.

The extracts and preparations from the thyroid glands of freshly-slaughtered animals are used for making up deficiency or for preventing or curing diseases due to their deficiencies in men.

Pituitary Body : The pituitary body is a lump of tissues about an inch in diameter attached to the base of the brain and situated in a depression of the sphenoid bone. It produces hormones or exciting bodies through its two lobes. The anterior lobe produces a substance which has profound effects in stimulating ovarian activity in females. It is traced in the urine of pregnant animals. It is the basis of the diagnosis of human pregnancy. It is used to excite œstrum in animals. The posterior lobe produces an exciting body on plain muscles and is used for its action on uterus in difficult parturition due to inertia of this organ.

Adrenal or Suprarenal Glands : These are two organs situated near the kidneys on its either side. The secretions of these ductless glands are poured into the blood stream directly. It weighs about one to two ounces and is about 3½ inches wide × ½ inch thick. Adrenaline is extracted from it which has the property of increasing the tone of the heart muscle and the rate of heart beat, and causing a constriction of the

blood vessels raising the blood pressure. Adrenaline is extracted usually from the glands of sheep.

The gland acts as a store-house for the energy of the sympathetic system.

Pineal Glands: It is located in a tiny cavity near the pituitary body. The secretions of this gland bring in puberty, maturing the sex organs, changing the voice, developing speech, shyness, excitability etc. in men, which are characteristic of adolescence. The gland is dormant in middle and later life.

The Gonads or the Sex Glands: These signify the testes in the male and the ovaries in the female. These organs make external secretions of sperm and ovum respectively for re-production. In addition to these external discharges, these organs make internal secretions which give the animals their respective physical and mental character. By the removal of the testes and ovaries in males and females before puberty the following changes occur:

IN MALES: The generative organs do not grow, the voice remains like that of young ones, the muscles become weak, the mental condition becomes dull and indifferent and lassitude supervenes. The individual loses his male characteristics, and on the contrary assumes those of feminine types. In a bull calf, the secondary sex characteristics do not make their appearance, such as the arched neck, the great body size, the broad forehead, the massive development of horn and the deep voice. The bullock is more like

a cow than a bull. Even the horns take the characteristics of the horns of the cow.

IN FEMALES : In human beings if the ovaries of females are removed, then the pelvis does not grow, the breasts do not develop, hair comes out on the face like that in males, the voice gets hoarse, the mental condition becomes inert, the woman loses the female characteristics and tends towards the male type. The removal of the ovaries of the cow will effect similar changes. In effect, a cow will behave somewhat like a free martin, a male in character but female by birth.

The internal secretions of the sex organs play the principal part in the development of sex characteristics.

1302. BODY HEAT AND TEMPERATURE.

Animals are divided into cold-blooded and warm-blooded, according to their body temperature. The cold-blooded animals include the invertebrates, the reptiles, amphibians and fishes. Their temperature varies within certain limits with the temperature of the surroundings.

The warm-blooded animals include the mammals and birds. Their temperature remains constant or practically constant, irrespective of the rise or fall of the surroundings temperature. In the warm-blooded animals the maintenance of this constancy of the temperature is effected by the balancing of the production and dissipation of the heat of the body. The chief source of producing heat in the body is the oxidation that takes place during the life process and

the movement of muscles. The cooling agents are the skin and the lungs. In the skin the mechanism of perspiration accomplishes the cooling. When the animal performs work, more oxidation goes on and it feels warmer. When the skin is warmer it gives off the excess heat by conduction, radiation and perspiration. On a cold day the loss of heat from the body would be much greater if the same quantity of blood were sent to the skin as on a hot day. But this is not allowed to happen. Cold causes the blood vessels of the skin to contract which, therefore, allows less blood to be supplied, and this checks perspiration and conserves heat. On a hot day the cooling by radiation will be little, the surrounding temperature being high. But the blood vessels of the skin dilate, bringing more blood to the skin and inducing more perspiration; this, on evaporation accomplishes cooling, serving to keep the body temperature at normal. The lungs also throw off much heat through the expired air in the form of moisture contained in it. In the hot weather more moisture passes out, helping the cooling of the system.

The normal temperature of animals vary within considerable limits. The normal temperature of the ox is 101·8 to 102·4°. The average in round figures for the ox is 102° F. For the horse it is 100·5° F. Cows in milk have a little higher temperature. The temperature is higher in youth and lower in old age.

Temperature is obtained with the help of the thermometer. The best place for obtaining the temperature is the rectum of animals. In cows the

thermometer may be put in the vagina, but it must be noted that the vaginal temperature is half a degree higher than the temperature at the rectum.

In cold-blooded animals, like frogs or snakes, this controlling mechanism is not operative, so that their temperature falls during winter and rises during summer. The cold of the winter makes these animals torpid, while the advent of the spring leads to vivaciousness, action and movements.

THE COW IN INDIA

Vol. II.

PART—VI

THE VETERINARY REMEDIES, MATERIA MEDICA AND PHARMACOLOGY

INTRODUCTORY

TO PART VI.

Materia Medica deals with the name, sources, distribution, composition and physical character of the various remedies used by the physician, and **Pharmacology** deals with the action of the drugs on the body. In the following pages some selected drugs are taken and their character etc. are described, and also mention is made of the uses they may be put to.

Pharmacy is an allied branch of knowledge. In our case no separate chapter has been devoted to dealing with the various pharmaceutical processes.

In dealing with the diseases where drugs are prescribed, the methods of preparing them, if there be any thing special, are given.

In Chapter 36 there is a list of remedies and the uses to which they are put, as also a list of diseases in which these remedies are used.

CHAPTER XXXV

VETERINARY REMEDIES

1303. ACID ARSENIOUS

White Arsenic. Arsenic trioxide. Arsenious Oxide.

It is a white, tasteless, odourless substance, soluble in water to the extent of one per cent.

Arsenic is a very strongly poisonous substance. It is antiseptic and parasiticide. For preparing hides for storing, arsenic is mixed with its equal weight of soda ash and dissolved in twice its weight of boiling water and diluted to 25 times its weight, or as prescribed by law for the export of hides and skins.

In small doses arsenic **stimulates** appetite and **digestion.** The most valuable therapeutic action of arsenic is on the blood-forming organs. It tends to increase the **leucocytes**-forming elements of the bone marrow. When, however, blood is changed by disease, arsenic stops the abnormal formation of leucocytes and restores the red cells to their normal proportion. In this way, it increases the number of red **cells** in pernicious anæmia and reduces the leucocytes in leukemia.

In therapeutic doses arsenic acts as a **stimulant** to the **nervous system.** In young, growing animals when they are in poor condition, arsenic creates a healthy change on the bones, making them denser. Arsenic

is believed to operate favourably in influencing the nutrition of animals.

It has a beneficial action upon the skin. It renders the hairy coat thick and increases subcutaneous fat.

Arsenic is one of the best drugs for **anæmia.** It has to be given along with iron and Nux Vomica or Strychnine. Small doses should be given at first which may be increased as tolerance for arsenic increases. With repeated dosing, the saturation point in arsenic administration will be evidenced by the swelling and itching of the eye lids. Arsenic can be usefully employed in Surra, in small doses, by mouth, rising up to 7 grains per dose twice daily.

Dose (adult as tonic) :—3 to 5 grains.

Poisoning : Arsenic is very largely used in the criminal practice of poisoning cattle. Being a tasteless, odourless, white powder it can be sprinkled over grass or may be given inside a plantain or mixed with molasses. 3½ to 7 drams will kill a large-sized cow.

Symptoms of poisoning : There is violent colic, rapid respiration, vomiting and great thirst. After a time purgation commences. Purgation is so severe that in **post-mortem** examination it is found that absolutely nothing is left in the stomachs or intestines. Severe purgation is followed by collapse and death.

If the case is advanced, recovery is rare. In early cases mucilaginous drinks are useful as helping to retard absorption. Linseed mucilage or *isafgul* may be given as drink in large quantities. Hydrated iron oxide prepared by precipating ferrous sulphate with

soda carbonate may be given in large doses to counteract the poison.

Strychnine and camphor in oil may be injected to strengthen the heart and retard its weakness and paralysis.

1304. ACID BORIC AND BORAX

Boric acid is a white powder, unctuous to the touch. It is soluble in 16 parts of water and has a faintly bitter taste. It is soluble in 4 parts of glycerine. Boric acid dissolved in glycerine is used as boro-glycerine for paints on injured mucous surfaces as in aphtha or in foot and mouth disease.

Boric acid is a non-irritant, weak **antiseptic** but cannot be classed as a disinfectant. It can prevent mould formation in some cases. In 2 to 4 per cent solution, it is a valuable surgical dressing. Boric acid mixed with starch or talc powder is used as a dusting powder.

Borax—Sodium Biborate: Borax is obtained usually in colourless, transparent crystals. It is soluble in 16 parts of water. Borax is the sodium salt of boric acid. It is less active than boric acid and can be used where boric acid is indicated. If put on glowing fire, borax loses water and is converted to a light, friable porous mass. This can be powdered and mixed with honey or glycerine in the form of a thin paste which may be used for protecting ulcered mucous surfaces.

Solution of borax in water, 2 to 5 per cent, may be used as a **mouth wash.**

1305. ACID CARBOLIC

Phenol. Phenic Acid.

Carbolic acid occurs as white crystals. But in summer heat it partly liquefies. It has a characteristic odour and a sweetish burning taste. It has a peculiarity that it is soluble in 5 per cent strength. In higher percentages it is not soluble. So that a water solution of carbolic acid can only be of 5% strength. If higher strength is required then the acid has to be dissolved in oil, forming carbolic oil. It is freely soluble in oil and glycerine.

Carbolic acid is a germicide. Its germicidal action varies with the kind of organism. In one per cent solution it kills **pyogenic** bacteria. Spores are very resistant and 5% solution will not kill anthrax and tetanus spores in 24 hours. One per cent solution is strong enough to prevent the growth of many organisms. Carbolic acid has greater affinity for oil than for water or proteids of the tissues. Therefore, carbolic acid in oil is more or less useless as an antiseptic.

Applied to the skin it makes it white and crimpled. Soon the epidermis is destroyed. To prevent great mischief when raw carbolic acid comes in contact with the skin, it is necessary to wash the site with oil repeatedly which, having a soluble action on the acid, takes off the uncombined portion. If carbolic lotion of 5 per cent strength is kept long in contact with the skin, it injures the skin and may set up local gangrene. Carbolic acid is toxic to most parasites, such as mange, mites, fleas, ticks etc.

Carbolic acid has a local anæsthetic action and can relieve the itching of pruritis for which object it may be used in 1 to 2 per cent. lotion or as a liniment. It has been credited with beneficial action in tetanus. The animals attacked by tetanus develop a special tolerance for carbolic acid.

Cats and dogs have a special intolerance for it, and it should not be used for disinfecting the places where dogs and cats are kept. Absorption of a little of it by these animals may prove disastrous.

1306. ACID SALICYLIC AND SODIUM SALICYLATE

Salicylic acid naturally occurs in the oil of winter-green and is also artificially prepared. It occurs as white, small, needle-shaped crystals and has a sweetish taste which develops into a acrid burning taste. It is very little soluble in water—its solubility being about 1 in 500. The sodium salt of the acid, sodium salicylate, is very generally used. Sodium salicylate is soluble in water. Sodium salicylate is to be used in double the dose of salicylic acid.

Salicylic acid: Solution of salicylic 1 in 500, exerts **antiseptic** action on micro organisms and inhibits the growth of **moulds** and **yeast.** It is largely used as a preservative for food, and it is a harmless preservative.

Salicylic acid is a **parasiticide.** It softens the epidermis and is helpful in the removal of corns without creating inflammation. It promotes the healthy growth of skin in skin diseases.

Salicylic acid is used for its parasiticide action for treating skin diseases from fungus, such as ring-worm. It is used to soften corns, warts etc. and is used for cleaning and dressing eczema. It checks perspiration and oozing out of serous matter and is, therefore, valuable in seborrhoea.

Dose :—1 dram to 1 ounce.

Sodium Salicylate : For internal use sodium salicylate is preferred for its solubility. It has a specific action on **rheumatic arthritis** and on muscular rheumatism. It removes pain and swelling. It lessens the danger of cardiac complication. **Injection** of a solution of sodium salicylate on a rheumatic joint has a charming effect. For administration by mouth it has to be given in combination with soda bicarb in fairly large doses.

Sodium salicylate may be used for checking fermentation in the digestive tract. It itself interferes with digestion but serves well for checking fermentation. In combination with soda bicarb, it lessens its irritating action on the stomach.

Dose :—2 drams to 2 ounces

For **Ring-worm** or **corn** etc. 5 to 10 per cent of Acid Salicylic is used in the form of ointment or in oil.

1307. ACID PICRIC OR TRINITROPHENOL

Picric is a yellow crystalline substance obtained by the action of nitric acid upon sulphuric acid or carbolic acid. It is soluble to the extent of one per cent in water. It is used for external

application as a lotion. In burns it acts as an **analgesic** and as an **antiseptic**. Gauze soaked in 1 per cent. solution (saturated solution) of picric acid is put on the burnt skin and lightly bandaged. On large surfaces or deep wounds too much use of it may cause absorption with a danger of poisoning. For eczema and scratches, it provides a good dressing. It stains the skin yellow. The crystals are stored under water according to legal requirements.

1308. ALOES : MUSSABBAR

Aloes is obtained by drying the juice of the leaves of the Aloe plant. It occurs in brown, opaque masses, having a pungent odour. It is partially soluble in water.

The principal use of aloes in veterinary medicine is as a **purgative**. Aloes serves as a good purgative in moving the over-loaded stomach. It sets up strong **peristalsis** and helps the removal not only of stagnant matter from the intestines but serves to expel the worms that have been deadened by the use of an anthelmintic drug.

Aloes requires 12 to 36 hours to produce purgation, and usually purgation does not commence earlier than 18 hours. It is, therefore, advisable to use it in combination with some other quick-working aperient, such as magnesium sulphate. Purgation may last 3 to 24 hours. In case of cattle, aloes is of less certain action than in the case of horses. The large mass of material in the rumen hampers its action. It is, therefore, all the more necessary in case

of cattle to use an assisting purgative along with the aloes.

The peristaltic action is the special utility of aloes. But it is rather violent, so that symptoms of colic may appear after the administration of aloes. The peristaltic action is most desirable in moving accumulated fæcal matter as also for the expulsion of worms.

Dose (as a purgative for cattle) :—½ oz to 2½ ozs.

1309. ALUM : ALUMEN : PHATKIRI

The alum of commerce is potassium alum. It is obtained in colourless, octahedral crystals or fragments of crystals, and has a sweetish, astringent taste. It is soluble in 7 parts of water.

Applied to the skin or mucous membrane, in solution, it acts as a powerful **astringent.** It precipitates the proteids of the tissue, coagulates the fluids and constricts the tissues. Alum forms a firm clot with blood and is, therefore, valuable in stopping bleeding.

For astringent action on mucous membrane 2 to 5 per cent solution may be used as wash for conjunctivitis, in metritis, pharyngitis, nasal catarrh and stomatitis. Where the sores of stomatitis are deep and extensive, the application of the saturated solution of alum with a swab is useful. It is not much used as an internal styptic.

1310. AMMON CHLORIDE : NISSADAL

Ammon chloride is a white, crystalline powder, giving a salty, cooling taste. It is very soluble in

water. In the industries it is used for soldering and making soldering fluids.

It serves to increase and thin out the bronchial secretions and is, therefore, chiefly used as an expectorant in bronchitis. Ammon chloride in large doses is said to act beneficially on ascites by relieving it.

Dose :—1 to 4 drams.

1311. ARJUN

Terminalia Arjuna.

Sans—Arjuna. *Tamil*—Vellaimarudamaram.

Terminalia Arjuna is a large deciduous tree. It grows in the sub-Himalayan tracts in the U. P., in Chota Nagpur and in the Deccan. It attains to a height of 60 to 80 ft. Its bark is a commercial product for use in tanning as also in medicine. Arjun bark is being used from the ancient times in heart diseases and in inflammations and dropsy arising therefrom.

It is very quick in its action. In heart diseases and in palpitations, its effect on the pulse is immediate and also lasting.

Recent researches prove the drug to be a cardiac stimulant and tonic, increasing the force of contractions and prolonging the diastole. It slows the heart without making it irregular, and never acts as a cardiac poison. It is invaluable in heart diseases where a combined tonic and stimulant action is required.

Its good effect in local inflammation is due to blood pressure. Experiments show that it causes the

contraction of the peripheral arterioles and increase the passage of the blood corpuscles through the vessel walls. For this reason, it acts with wonderful efficacy in local inflammation of the heart. As a diuretic it is also very effective.

Dose :—½ to 1 ounce of bark.

To be administered in powder form in gruel.

1312. BISMUTH CARBONATE

Bismuth carbonate is an insoluble, white powder without odour or taste. Bismuth carbonate and other bismuth salts are used for their local action. Given by the mouth, they adhere to the mucous membranes of the stomach and intestines and form a protective coating over them. This saves the surfaces from irritation and, therefore, ulcers and injuries in the tract find opportunity to heal. The coating on the mucous membranes of the stomach and intestines exerts an inhibitory action on their secretions, and peristalsis is diminished. In this way, it checks diarrhœa. There is a deposition of metallic bismuth on the linings in black form. The fæces, therefore, on administration of bismuth become black.

Externally it is used for dusting on wounds, burns and on skin in skin diseases. It dries secretions and protects and covers the wound and shows marked healing effects. Its healing effect is more striking in internal ulcerated surfaces. Internally it also serves to check nausea, vomiting and irritation of the tract in gastritis. In diarrhœa, when the intestine is inflamed, it exerts a powerful soothing action and is a very

valuable remedy. It is eminently suitable for use in white-scour and coccidiosis, gastric ulcer, gastritis, and other similar disturbances of the digestive tract.

1313. BONE-MEAL : BONE-ASH

Bone meal is powdered, steamed bone. It consists of calcium phosphate and has besides some proteins in it. Bones are sterilised and then usually passed through a one-tenth inch screen.

Bone meal supplies **calcium** and **phosphorus** when mixed with the feed of animals, deficient in them. Calves should have a portion daily. The older ones may have bone meal as corrective. It is indispensable in rice areas. It is useful in rickets. Bone ash may be used in place of Bone meal.

Dose :—2 to 4 ounces per day.

1314. CALCIUM CARBONATE

Calcium plays a vital part in nutrition. The bones are made of calcium in the form of calcium phosphate. Any deficiency of calcium in food, therefore, reacts upon bone formation. Calcium is also useful for the regulation of **muscles, nerves** and **glands.** Calcium gives the character of **coagulability** to blood. The presence of calcium in proper quantity and proportion in blood and, therefore, in food, is essential. The working of the deposition of the bone material in bone is a complete thing, and many factors contribute to the healthy growth of bone. In **rickets** and **osteomalacia**, deficiency of calcium may be one of the principal contributory factors, although deficiency of phosphorus may be

equally responsible for it. They are, therefore, attempted to be corrected by the administration of calcium. Calcium carbonate is one form in which calcium may be given in rickets. Calcium carbonate is an antacid and can be used for correcting excessive acidity in **gastritis.** Calcium carbonate is chemically the same substance as chalk. **Chalk** may be used for feeding cattle. Lime stone in powder form also will serve the same purpose.

Dose :—I to 2 oz.

1315. CALCIUM CHLORIDE

Calcium chloride occurs as white fragments. It has a sharp saline test and is very deliquescent. The solids absorb moisture from the air and become fluid if kept in the open for any length of time. It is very soluble.

Calcium chloride possesses the property of coagulating blood, both inside and outside the body. This result is obtained by administering the drug internally. **Calcium gluconate** is not an irritant but serves the same purpose and has largely replaced its use.

Dose :—¾th to 1½ drams.

1316. CALCIUM GLUCONATE

Calcium, on account of its property of coagulating, is used to stop bleeding by coagulation. Calcium has a place both for internal bleeding and bleeding from cuts and wounds. For both internal and external bleeding calcium gluconate may be used orally and intravenously.

For oral use for internal hæmorrhage, the dose of Calcium Gluconate for cattle is ½ to 1 oz. It is recommended for internal bleeding and hemophilia. For stopping serious bleeding from wounds it may be injected on the bleeding surface hypodermically or intramuscularly. For intravenous or intramuscular use, 5 to 19 per cent solution should be used. Not more than 5 or 10 c. c. should be introduced intravenously, and the introduction should be slow. It is better not to use the intravenous route.

Calcium deficiency causes **parturient paresis** or milk fever in milch cows. Strikingly successful results are obtained by the introduction of calcium subcutaneously. The mixture recommended by Greig and adopted with success is as follows :

Calcium Gluconate ...	2 oz.
Boric acid	3 drams
Water	14 ounces.

They are boiled together to ensure complete solution, and then cooled and slowly introduced subcutaneously.

1317. CALOMEL : MERCUROUS CHLORIDE

Subchloride of Mercury.

Calomel is a white, odourless powder, having a persistent metallic taste. It is insoluble in water. Calomel is a mild preparation of mercury which can be absorbed from all surfaces of body and can, therefore, be administered as powder by mouth or as inunction mixed with soft paraffin.

Mercury has strong **antiseptic** properties. It forms albuminoids with the proteids of the tissue. Calomel also has these properties to a certain extent. In medicinal doses calomel is a **cathartic**, which ensures copious discharge and unlike many cathartics, is not attended with pain. It has a stimulating action upon the kidney and, therefore, acts as a **diuretic**. The diuretic action is particularly evident in cases in which there is a large accumulation of fluid in the body as in ascites or dropsy. In glandular or other swellings of a serous or fibrinous nature, calomel is useful. It has strong antiseptic and **bactericidal** properties for which it is used in fractional doses in cholera in man.

In cattle it is used as an intestinal antiseptic. In **diarrhœa** of the young, calomel acts as an antiseptic and also helps the expulsion of the irritating matter.

For its diuretic action and for its action in inducing the flow of bile, it is successfully used in **jaundice** and in **dropsy** etc. for the removal of serous fluid.

Calomel is a vermicide in the case of **round worms**, where its action has to be aided by the combination of some other parasiticide.

Externally it is useful in eczema in combination with zinc oxide ointment, in 5 to 20 grains to the ounce.

As a dry powder mixed with zinc oxide it acts as an antiseptic and desiccant in moist **eczema**.

Like other preparations of mercury, calomel remains in the system for some time and may have

a cumulative effect and induce mercurism or the poisoning effect of mercury. The first symptom of mercurism is noticed in the mouth. The gums and teeth become sore, and then they swell and salivation begins. The tongue and glands become enlarged, the whole face swells, the teeth get loose and fall off, the breath becomes foul. Care should be taken at the early appearance of any of these symptoms to stop the administration of calomel till the symptoms are over. As a general measure of precaution, administration of calomel should be followed up by a dose of **mag. sulph** the next day so that there may be no accumulation of it in the system.

When signs of soreness, salivation or swelling of the mouth occurs, potassium chlorate should be used for wash and given internally in ¼ to 1 dram doses. The system should be cleaned of mercury by the free use of aperients like magnesium sulphate. For mouth wash 10 to 20 grains of potassium chlorate per ounce of water should be used.

1318. CAMPHOR

Camphor occurs in white, crystalline masses. It has a sweet characteristic odour. It is soluble in alcohol but is very slightly so in water.

Camphor is a mild **antiseptic** and **insecticide.** It is an irritant to mucous membrane and subcutaneous tissues, and is, therefore, used as an ingredient of liniments. Camphor is a circulatory **stimulant** and is used to revive the circulation when the automatic centres of the heart begin to fail. It has also a

stimulating action upon the nervous system. Camphor serves to relieve internal **congestion** and is, therefore, used **in cold**, in **bronchitis** and **pleurisy**, also in congestion of the liver.

Camphor occupies a large place as an ingredient of **rubifacient** liniments for sprains, bruises, in mastitis and in rheumatism. It has some anti-spasmodic action which adds to its property of relieving congestion, thus making it valuable in diseases like bronchitis.

In liniments camphor may be used with turpentine in a medium of oil.

For intramuscular injection :

Camphor............1 part
Oil arachis (ground nut) 5 parts.

Heat to dissolve—when cold inject in doses of ½ to 1 oz. Camphor in oil injection should be given intramuscularly and not subcutaneously, because abscess may form if subcutaneously given.

For internal use, the dose is 1 to 4 drams, to be given mixed in molasses.

1319. CATECHU

Catechu is an extract of the twigs and wood of the catechu tree. The extract is cast into cubes or sold as thick flakes. It is soluble in hot water or nearly so.

Catechu contains 45 per cent of catechu tannic acid, and is an anti-diarrhœal. Anti-diarrhœals act by reducing peristalsis. Treatment of diarrhœa consists in removing the irritating materials by purgation and

in giving a protective coating to the injured surface, as is done by castor oil, in checking peristalsis and in producing an astringent action, such as by the use of tannin preparations like catechu and mineral perparations like bismuth.

Catechu acts as an **astringent** upon the mucous membranes. It is superior to tannic acids for the fact of its containing other organic materials in it in the form of gums and resins, which do not act in the stomach but pass on to the intestine.

Before the use of astringents like catechu in **diarrhœa** or **coccidiosis** it should be seen that the irritating materials have been expelled from the intestines by the use of aperients like castor oil etc. Catechu may be usefully combined with chalk (calcium carbonate) or with opium.

Dose :—2 to 4 drams for adults.

1320. CHARCOAL (wood)

Charcoal made from wood has a spongy structure. Charcoal has the property of absorbing many times its volume of oxygen. By keeping oxygen in its pores, charcoal acts as an oxidising agent. Charcoal itself is not absorbed by the system and, therefore, acts only locally. In wounds, dry charcoal powder may be dusted for dressing, where it acts as a **desiccant** and **absorbent**. In intestinal affections like gastric ulcer and coccidiosis it is used with good effect in that by supplying oxygen locally, it stops the putrefying processes that might be going on and acts as a covering also, as it does in external wounds.

Charcoal should be prepared fresh or otherwise heated to redness, then cooled in order to get the best result.

Dose :—1 to 2 oz. for adult animals.

1321. CHLORAL HYDRATE

It occurs in crystalline form having an acrid penetrating odour and bitter caustic taste. It is freely soluble in water. It is used as a **hypnotic** and in large doses serves the purpose of general **anæsthetic**, producing unconsciousness and insensibility. In moderate doses it depresses the cerebrum but has no appreciable effect on the respiratory and the circulatory system. It produces deep sleep lasting for several hours. It relaxes the muscles. In large doses it depresses all nerve centres and serves as an anæsthetic for operations. In excessive doses of 5 to 9 ounces it may produce death. If the animal is kept warm it is able to withstand large doses than without being so kept. Strychnine may be used as an antidote in poisoning.

Chloral hydrate is preferred to chloroform and morphine as a narcotic drug for surgical operations. It produces medium narcosis sufficient for the purpose. The narcosis lasts for one or two hours.

It is very much in use as a hypnotic in all conditions when the animal is over-excited or the nerves are high-strung. For this purpose it is usefully employed as an anti-spasmodic in **tetanus convulsions** and **meningitis**. In **prolapses** of the organs, such as of rectum, vagina or uterus, it relaxes the muscles

and facilitates the return and retention of the prolapsed part.

Dose :—Narcotic – ½ to 4 ounces.
Sedative – 1 to 2 ounces.

Chloral hydrate is irritant to the mucous membrane. When given by mouth it has to be well diluted with mucilage to the extent of 1 oz. chloral hydrate to 3 pints of mucilage. Milks gives the following formula :

Chloral hydrate	...	2 oz.
Acacia	...	1 oz.
Water to	...	6 pints.

In prolapses 1 oz. dose is recommended. It can be given by the rectum also in the same dose as per mouth. Smaller doses will check **vomiting**.

For intravenous injection it may be given in 10 grains dose in 100 c.c. of water in meningitis. In poisoning by chloral hydrate artificial respiration should be resorted to and caffeine and strychnine should be injected. Death occurs through respiratory failure.

1322. COPPER SULPHATE : BLUE VITRIOL

Beng.—Tutia.

Copper sulphate occurs as deep blue crystals or granular powder having a nauseous metallic taste. Soluble in water 1 : 3.

Copper sulphate is used as an **astringent, caustic, vermicide** and **emetic.** In dilute solutions it is astringent. In concentrated form it is caustic.

Internally it causes vomiting. It is internally used also as a vermicide.

Copper salts are poisonous to lower forms of plant life and also to the snails etc. In solutions of 1 : 1000, copper sulphate acts as an **antiseptic**. Water, with the slightest blue tinge, can be used for dressing. In dressing wounds copper sulphate removes the slough and leaves the wound surface red, enhancing healing.

As a vermicide it is commercially used in making starch pastes for book-binders. Vermins do not attack such paste, and during storage the paste does not become mouldy.

In one per cent. solution it is used as an **anthelmintic**. Combined with Kamala it has proved the most efficacious anthelmintic for most forms of parasites that infect the stomach and the intestinal canal of the cattle.

Solution of copper sulphate causes a vomiting tendency in small doses. This property is taken advantage of in using it as an expectorant in catarrh and bronchitis.

Copper is not a component of hæmoglobin, but its presence is necessary for iron to form hæmoglobin. Animal food usually contains enough copper to serve the above purpose. But when there is deficiency of copper in animal food, anæmia results. In order to combat this, slight dosing of copper is resorted to. It may be given in the form of sulphate, but it is better administered in the form of lactate. *Dahi* contains lactic acid. If a clean copper coin is placed in *dahi*, it becomes blue, copper having gone into solution.

Stockmen in India are in the habit of scenting copper deficiency in **anæmic** cattle and correcting that by the use of copper-contaminated *dahi* as indicated above. For this purpose the minutest quantity $\frac{1}{50}$ to $\frac{1}{10}$ grain is enough.

Copper sulphate is a prompt emetic, but it should not be repeated if the first dose fails to act. The emetic dose for cattle is $1\frac{1}{2}$ dram to 6 drams in one to two per cent solution.

For anthelmintic action it is safest to use it in one per cent solution or 5 grains to the ounce. 4 to 10 ounces is necessary for adult and correspondingly less quantity for the calves.

Its caustic action is taken advantage of in the sores of stomatitis, conjunctivitis and for fistulous tracts. In these cases a crystal is touched on the surface. In fistulous parts it may be used in strong aqueous solution of 3 to 15 grains to the ounce.

1323. CREOSOTE

Creosote resembles carbolic acid in action and has no advantage over it in external use, but it is much less irritant and toxic, although large doses cause all the symptoms of poisoning by carbolic acid. It is particularly valuable in **bronchitis**. It has proved of considerable value is canine distemper, acting as an intestinal **antiseptic** as well as an **expectorant.**

It is used as an intestinal antiseptic in intestinal catarrh. Creosote is used largely in human dentistry to relieve toothache acting as an **anæsthetic**.

Creosote may be administered by thorough incorporation in a neutral substance like Kaolin or chalk. The dilution should be one dram to one ounce of medium.

Dose, (internal) :—20 to 40 minims in gruel or with Kaolin.

1324. FERROUS SULPHATE

Copperas, Green Vitriol, Sulphate of Iron.

Hindi—Kasis, Heerakash.

Ferrous sulphate is a green, crystalline, water-soluble substance obtained by the interaction of sulphuric acid on iron. It oxidises to a ferric state and if exposed to air, even in corked phials, the green colour changes to brownish yellow on the surface and the reaction gradually penetrates to the interior. Where crystals have changed colour they should be dipped in dilute sulphuric acid when they revert to the original colour. The green crystals only should be used.

Iron is administered in the form of iron sulphate. Iron is a constituent of the hæmoglobin of blood. Iron deficiency in the system leads to anæmia. The rectification of anæmia is a complicated matter depending upon the various influences working on the system, one of which may be iron deficiency. Such deficiency can be made up by giving small doses of ferrous sulphate. Internally iron in the form of ferrous sulphate acts as an **astringent** and its use is indicated, therefore, in cases of obstinate **diarrhœa**. At one time it was believed that iron for absorption should be administered in organic form. It has been proved

that the belief is erroneous and that inorganic iron is better absorbed by the system. Ferrous sulphate acts to an extent as a **styptic** also.

Dose:—2 to 3 drams dissolved in sufficient water.

1325. IODINE, TINCTURE & LUGOL'S SOLUTION

Iodine is obtained from the ashes of seaweeds. It occurs as bluish black, friable crystals with a metallic lusture and characteristic odour. It is used in solution of spirit or of potassium iodide or both. Iodine preparations in the form of potash iodide or idoform have found general use.

Free iodine is a very useful **counter-irritant.** It remains for a time at the point of application on the skin and then penetrates. The usual form of applying iodine is as tincture.

Tincture iodine :—

Iodine	...	7 parts
Potash Iodide	...	5 parts
Water	...	5 parts
Alcohol	...	to 100 parts.

Lugol's solution :—

Iodine	...	5 parts
Potash iodide	...	10 parts
Water	...	to 100 parts.

Iodine has a strong **antiseptic** and **germicidal** action. Articles to be disinfected may be dipped in water, containing just enough of tincture iodine or Lugol's solution to give it a tint. Gauze dipped in

such iodine lotion serves as an antiseptic dressing for wounds.

Applied to cuts, iodine at once **disinfects** and arrests inflammation and removes the chance of pathogenic bacteria finding entrance through the cut surface. After a calf is born the navel is to be bathed in tincture of iodine, which has to be applied daily till the dry part falls off. Iodine remains absorbed in the tissues after application, hence it retains its effect in protecting cuts and wounds when it is applied on the spot and the surrounding area.

It kills fungus growths and is, therefore, useful in **acne, actinomycosis** and in **ring worm**. It has got **bactericidal** properties and, therefore, when given intravenously in infections like bronchitis and pneumonia, it cuts short the course of the disease.

When pyogenic bacteria infect the cavity of the mouth, the larynx and pharynx, a paint of mild tincture of iodine or Lugol's solution ensures the prevention of infection and gives local comfort on account of its action on the mucous membrane. For this purpose a little admixture of glycerine makes it a valuable throat-paint.

In mumps, if injected in or around the glands, it helps quick recovery.

In goitre its superficial application helps absorption.

Iodine as tincture or as Lugol's solution is a very handy substance both for internal and external application, there being a variety of uses in daily practice.

1326. IODOFORM

It is a lemon-coloured powder, having a characteristic very penetrating odour. 1 part is soluble in 80 parts of glycerine. Iodoform is a mild antiseptic to raw surfaces and mucous membranes. It has got slightly germicidal properties. It is easily absorbed from raw surfaces and quickly appears in the urine as iodide. It is used solely externally for infected wounds. In ulcers it is a valuable dusting powder. It may be used as an ointment, in 10 per cent strength. In deep wounds, in fistulous tracts and in rectal, nasal and vaginal cavities it is used in the form of a gauze for packing. A plain gauze dusted with iodoform will serve the purpose. It may also be injected into the cavities in solution in oil or glycerine. In metritis and for retained placenta, up to an ounce may be introduced in the uterus with gauze or directly as suppositories.

1327. KAMALA

Kamala is a heavy reddish powder, being the glands and hairs from the capsules of Mallotus philippensis, indigenous to India, China and the Philippines. It is a powerful parasiticide and is being used in *Ayurvedic* medicine from the long past. Very recently researches by the Imperial Council of Agricultural Research have established the very important place it should occupy in veterinary practice as an internal parasiticide in combination with copper sulphate. It may be given in milk, honey or syrup.

Dose :—1 oz. to 1½ oz.

1328. KAOLIN : CHINA CLAY

Kaolin is white clay out of which porcelain ware is made. It has a soft and slippery touch and swells up with addition of water. Mixed with glycerine it is used as the basis of absorbing essential oils or thymol etc. used for external application, of which products like antiphlogistine are examples.

Kaolin in the stomach works as an **absorbent** for offensive matter in the gastric tract and helps their expulsion. Kaolin mixed with charcoal powder can be used for diarrhœa and dysentery.

When kaolin is not available, ordinary **sticky clay** may be used in its place after preparation. Clay from some depth below the surface is taken so that it may be in a clean condition and free from surface dirt. It is mixed in a paste and then thinned down and allowed to settle for one or two minutes when the larger grits and sand fall down. The supernatant layer is poured off into another vessel, stirred with some more water and allowed a few minutes to settle, to free it from the remaining sand. The muddy liquid at top is poured out into another vessel and allowed to settle down.

The process is repeated till the deposit becomes free from sand and grit. The deposit of fine clay is then taken up in some water and boiled to sterilise it and then allowed to settle. The settled clay is dried in thin layers in the sun or over a water bath. This substance may be used as Kaolin substance.

In acute diarrhœa, due to bacterial attack, Kaolin and wood charcoal powder in doses of 1 lb. of the

mixture of the two in proportion of 3 : 1, is very helpful. For milder attacks of **diarrhœa** and **coccidiosis**, smaller doses are given.

1329. MAGNESIUM SULPHATE

Epsom Salts.

Magnesium sulphate occurs in small colourless needles, having a bitter saline taste. It is easily soluble in water.

A saline substance like magnesium sulphate on reaching the intestines wants to be thinned down to the strength of normal saline and, therefore, absorbs fluids from the system and throws them out with purgation. Therefore, unless it is desired to remove the fluid from the system it should be well diluted on being given, and the animal should be induced to drink plenty of water. When, however, as in the case of dropsy or ascites it is desirable to expel fluids from the system, it need not be diluted with much water.

In concentrated solutions it causes nausea and vomiting, which should be avoided by adding sufficient water.

Magnesium sulphate is specially suitable for **purgative** action in the case of the ruminants. Addition of sodium chloride in equal weight is sometimes recommended to increase its cathartic action. In febrile condition it may be given in small doses with drinking water as it tends to lower the temperature and stimulate the action of the bowels. It has been found useful in **tetanus** when given as subcutaneous injection. Dawson and others recommend administering

20 c.c. of a 10 per cent. solution every 15 minutes subcutaneously. In **sprains**, in case of **inflamed joints**, a saturated solution of magnesium sulphate, applied on moist cotton or bandage, proves useful.

Magnesium sulphate is an antidote to poisoning by lead salts. Lead salts are converted into insoluble lead sulphates by it, which also assist their removal. It is also an antidote to carbolic acid poisoning with which it forms non-toxic carbolates.

Dose :—1 to 2 lbs.

1330. MYROBALAN (Fruits)

Hind.—Har, Harra. *Beng.*—Haritaki.
Tam.—Kadukkay. *Tel.*—Karakkaya. *Guz.*—Harle.

Myrobalan is a safe and effective **aperient.** It has been extolled as an effective cure **for pain** in the bowels, **flatulence, palpitation,** and has been maintaining this reputation. **Sores** in the mouth and the tongue which continue for months can be cured by myrobalan paste. 50 to 60 fruits make a full dose for having a good **purgative** action. It expels **round-worms** also. **Constipation** can be cured by it even in weak animals.

It is wonderfully efficient as an **astringent**. It can be successfully used for applications as a paste in water or oil for chronic ulcerations, ulcerated wounds and skin diseases attended with profuse discharge and in piles and prolapse.

Dose :—Purgative—6 to 8 ounces of pulp of the fruits in paste or powdered and mixed with water.

1331. NEEM (Leaves)

Melia Azadirachta.

Sanskrit—Nimba. *Tamil*—Vembu.

It is a large, ever-green tree 40 to 50 ft. in height. It is common all over India. The leaves are reputed to be efficacious in various skin affections. *Neem* leaves may be used as poultice, ointment or liniment in ulcers. These leaves boiled in water possess antiseptic properties and may be used for washing wounds. 20 small leaves per ounce of water boiled for a few minutes is an excellent antiseptic lotion.

The leaves are bitter. The cattle take them greedily. The *neem* may also be used as a tree fodder.

1332. NOVOCAIN

Cocaine has some undesirable properties and, therefore, substitutes are in use which are less toxic than cocaine. Novocain is one of them. It occurs in colourless needles. It is soluble in water. Injected subcutaneously it creates a strong but transient anæsthetic action. It is quite unirritating. It is not suitable for operations in the eye or the throat. It is used in 0·5 to 2 per cent solution in 10 to 20 c.c. doses for local anæsthesia to be injected in the skin.

1333. NUX VOMICA : KUCHILA : STRYCHNINE

Nux vomica is the seed of the fruit of Kuchila or strychnos nux vomica plant of India. It is a button-shaped disc about one inch diameter and $\frac{1}{8}$th inch thick. It is nearly flat or irregularly bent. The

surface is covered with a satin-like hairy coat. It contains about 1·25 per cent strychnine. Brucine is another alkaloid contained in it.

Nux vomica is used in the form of powder. For purposes of injection the alkaloid strychnine is used. The action of nux vomica is due to the strychnine content of it.

Nux vomica is an excellent tonic for stomach. It improves appetite and helps digestion. It improves peristalsis and, therefore, removes constipation by giving tone to the muscles of the stomach. For this object nux vomica may be better continued with some aperient. Combined with iron and arsenic it is the most beneficient tonic. It relieves over-loading of the rumen when combined with a purgative.

It is a strong **nerve stimulant,** and is very effective in removing nervous fatigue or exhaustion of the nervous mechanism. In **paralysis** when the nerve is not entirely destroyed strychnine is very helpful. It is useful in paralysis of the perpiheral nerves, such as facial paralysis.

It is a respiratory and **circulatory** stimulant, although its action on the circulatory system is not very pronounced. The heart is slowed and the blood pressure raised by it, due to the action on the central nervous system. It has, however, no direct action on the heart. In pneumonia, in failing heart, strychnine is indicated and its beneficial result may be due to the respiratory stimulation. In the depression of the respiratory system strychnine is indicated.

Strychnine is an antidote to poisoning by chloral hydrate, opium, morphine etc., when it should be given in full dose subcutaneously.

Dose :—Powdered Nux Vomica—1 to 2 drams.

Strychnine hydrochlor—0·3 grains in 4 c.c of water.

For hypodermic injection prepared tablets of strychnine should be used.

1334. OIL CASTOR

Oleum Ricini.

The oil is expressed in cold from castor seeds. It is one of the best aperients and cleaning agents for the bowels. It is safe for calves. As a purgative in larger animals it has not much value, while it is invaluable for calves. The best form of administration is as an emulsion with gum acacia mucilage or starch paste. The oil is made into paste with these sticky substances and on rubbing and adding water little by little, the whole mass becomes milky in which the oil globules are diffusely scattered. In this form it acts as a lubricant in the intestines and in combination with its laxative action clears away the accumulated debris without any injury to the intestinal mucosa. Therefore, it provides one of the best materials we have for treating **diarrhœa** in young animals. When new-born calves do not freely excrete meconium, castor oil emulsion in 2 dram doses of oil, is useful. Whenever there is any digestive trouble with the calf, either in the form of constipation or diarrhœa or foul smelling matter in the excreta or bloody stool, castor oil emulsion is the medicine of choice. The dose should be varied

according to age. For calves about one month old 2 drams oil per dose, 3 or 4 doses a day, is effective. For larger ones the dose should be increased. Animals above 9 months may be given 4 ounces per dose. Adult cattle require 16 to 20 ounces of oil for laxative action.

1335. OIL CHAULMOOGRA

The fatty oil is expressed from the seeds of *Hydnocarpus wightiana.* The oil may be used alone as an ointment for various skin diseases for external use. It can be given internally.

The oil has a high place in the treatment of leprosy in men for which it is regarded as the most valuable remedy.

In veterinary practice Chaulmoogra oil is reported to have been used somewhat successfully in **Johne's disease.**

Leprosy is caused by acid fast bacilli, so is John's disease ; so there is that likeness between the two diseases which has made research workers turn their attention to it for the treatment of Johne's disease. It is an extremely irritating substance. ½ to 1 dram by mouth mixed with gruel may be tried.

1336. OIL TURPENTINE

Oil Terebenthine.

It is a thin, colourless fluid, having a characteristic odour. It is an irritant to the skin and may produce from redness to pustules, according to the time and vigour of application. It is an **antiseptic, deodorant**

and a **verimicide.** As a **counter-irritant** it has great value in veterinary practice. Liniments containing turpentine, camphor and thymol in a medium of a bland oil are made for rubifacient and counter irritant action on skin in various inflammatory diseases such as bronchitis, pleurisy, pneumonia etc. These materials may be incorporated in clay and glycerine.

In muscular rheumatism and pains, such liniments give great relief. Turpentine has a styptic action and can be used in small doses for stopping internal hæmorrhage.

Turpentine has a place amongst the anthelmintics and can be used for destroying round worms. Turpentine has a **carminative** action also.

Dose :—Carminative 1 to 2 ozs.
Anthelmintic 2 to 4 ozs.

It is to be given mixed in 4 times its bulk of **arachis** or **cocoanut oil** and made into **emulsion** or with **gruel.**

1337. OPIUM & MORPHINE

Afim.

Opium is the dried secretion which exudes on incising the pods of poppy. It is a blackish, pasty, sticky substance with a characteristic odour.

Opium contains several alkaloids, the chief of which is morphine. Morphine generally represents the action of its mother substance, opium.

Opium contains not less than 9·5 per cent. of morphine. Opium and morphine are largely used in human therapeutics for relieving **pain, nervousness** and

excitement, as a **sedative** for diminishing secretions and as a **hypnotic.** In veterinary medicine opium has not the same importance that it has in human medicine, and its action is not so marked and specific. Chloral hydrate has more general appliance in veterinary practice as a hypnotic than opium or morphine.

In colic pains it is useful in arresting peristalsis and spasm of colic, if given in small doses. In acute intestinal catarrh and diarrhœa, by checking peristalsis, opium serves as a very useful and effective cure. In perforation and bleeding from bowels, opium is very efficient. It allows clots to be formed by checking the movement of the intestine.

Opium depresses the respiratory centre and exerts a soothing action in troublesome cough. It is indicated in bronchial affections when cough does not come out freely, causing distress. Where the flow of bronchial secretion is free, opium is harmful, because by interfering with the cough, it allows accumulation and complicates the conditon, retarding recovery.

Morphine is used by way of subcutaneous injection as a sedative in bronchitis, as above indicated in colic, for quieting the patient, and relieving spasms in tetanus, in relieving pain such as that of gall stone, for action upon the digestive system in diarrhœa, intestinal catarrh and peritonitis ; in soothing the distress of pleurisy opium is to be preferred.

Dose :—Opium 1 to 2 drams.

Morphine Hydrochlor for subcutaneous injection, in tablet form 2 to 4 grains.

1338. PAPAYA MILK

The milky juice that comes out on scratching the surface of the raw papaya fruit contains an enzyme which can digest starch and dissolve mucous membranes and animal proteins.

Papaya juice is dried at a low temperature. It may be dissolved in glycerine raw, as it comes out and the solution used for internal administration as well as a lotion for dissolving warts.

It is very useful in dyspepsia and liver complaints. It has got anthelmintic properties and may be rubbed over ringworm patches with success. Papaya milk rubbed in water and glycerine may be used as a paint for dissolving diphtheria patches. The juice contains the enzyme which is superior to animal pepsin.

Dose :—1 to 5 per cent. solution of the papaya milk in glycerine syrup or honey and water.

1339. POTASSIUM IODIDE

Potassium iodide occurs as colourless crystals. It has a sharp saline taste. It is very soluble in water. It is rapidly absorbed in the system where it causes secretions to occur. Therefore, when secretions are dried up and require flow, free administration of potash-iodide gives the requisite thing. It irritates the stomach. In large doses or in repeated doses it causes iodism. Iodism exhibits itself in pain in the frontal region, sneezing, running at the nose, soreness of throat, lachrymation, increased secretion of saliva. The drug eliminates itself by these routes.

In **actinomycosis** and **tuberculosis** etc. potassium iodide acts upon the necrosed tissues and causes their liquefaction and absorption. Potassium is absorbed and gives iodine strorage to the thyroid gland which is the depository of iodine in the system.

In actinomycosis, the internal administration of potassium iodide and local application of tincture iodine causes cure. They are regarded as specifics in actinomycosis. In **rheumatic arthritis**, potassium iodide often does remarkably beneficient service. In **bronchitis** and **laryngitis** it thins the viscid secretions and acts as an expectorant. It helps to resolve glandular swellings from any cause and is also credited with the power of causing absorption of serous effusions. It increases the activity of the thyroid gland.

Dose :—1 to 2½ drams.

1340. POTASH PERMANGANATE

Potash Permanganate occurs in dark crystals. It has an astringent, repugnant taste. Solubility 1 : 14. It is an oxidising substance, and as such exerts powerful antiseptic and deodorising action which it does by giving up oxygen in the presence of organic matter. It is valuable, therefore, in cases like **metritis, sotamatitis, fœtid ulcer** in 1 or 2 per cent. solutions for dressing and washing.

Potassium permanganate is used as an antidote for alkaloid poisoning when it is used in dilute solutions for washing out the stomach.

1341. PUNARNAVA : BŒRHAVIA DIFFUSA

Sans.—Shothaghni. *Hindi*—Sant. *Punj.*—Itsit. *Bomb.*—Ghetuli. *Tamil*—Mukukrattai.

It is a creeping herb which grows wild and is found in fields and gardens. Its beneficial actions in **dropsy** and **anæmia** and **heart diseases** are being extolled from the ancient times, and Punarnava has passed the ordeal of modern pharmacological research.

The active principles of Punarnava is a body of the nature of alkaloid called Punarnavine. Large quantities of potassium salts are present in the plant. The drug acts best when the dropsical condition is associated with healthy kidneys. As regards dropsy, due to cardiac conditions, its effect does not appear to be very marked. The drug appears to have a much more powerful effect on certain type of **ascites** than some of the other diuretics known.

Dose :—3 oz. dry or 2½ lbs. green.

1342. SALINE (For infusion)

Normal saline solution is an 0·85 per cent solution of sodium chloride in water. This corresponds to a teaspoonful of salt in a pint of water. But pure sodium chloride is not the best salt for injection. There should be some potassium and calcium salt in the solution. On account of this, ordinary or table salt, dissolved in hard drinking water, is better than the solution of pure sodium chloride in distilled water, for purpose of infusion. For this purpose 4 grains of calcium chloride per pint may be added.

Normal Saline :—

Ordinary Sodium chloride	... ...	90 grains
Calcium chloride	... ...	4 grains
Water to	... ...	1 pint.

When, due to bleeding or other causes, there has been a diminution in the volume of blood, or when the serum has gone out leaving the blood thicker than normal, then the infusion of saline can, for the time being, make up for the deficiency.

It is held that 25—30 per cent. of an animal's blood may be removed and replaced with normal saline without any bad effects. Infusion helps the regaining of normal arterial pressure and the kidneys begin to act which had been shunted off from receiving the circulatory blood on account of its low pressure. Its effect on respiration is increase in frequency and depth. Too much infusion leads to breathing difficulty, and this is followed by œdema of the lungs followed by death. In human subjects infusion should be stopped as soon as there is a feeling of uneasiness expressed by the patient. But in animals the pressure on the arteries should be the sole guide, and it should be carefully watched that the pressure does not go up.

When hæmorrhage is still in progress, infusion checks it by increasing the coagulability of blood. At the same time infusion makes up for the lost volume.

Saline may be given by the intravenous route or subcutaneously, and occasionally intra-peritonially. The choice of routes depends upon the urgency of

the case. The quantity introduced may be 2000 to 6000 c. c. for a cow according to the size and loss of fluid. Better results are obtained by mixing 7 to 8 per cent of gum arabic with the saline, straining and sterilising it by boiling and then cooling it for use. By this last method a very large volume of loss of blood may be made up by infusion of much larger quantities without injurious effects.

1343. SODIUM BICARBONATE

It is a white, opaque powder with a faintly saline taste. It is soluble in 1 : 10 of water.

It is a solvent for the dry exudates cf mange and eczema. It dissolves mucus but is sedative to the mucous membrane. It is, therefore, used as a lotion in washing rhinitis and other catarrhal surfaces.

In burns and discomfort of skin, its solution acts as a sedative.

It is **antacid** and neutralises gastric acidity. When there is excessive acidity, sodium bicarbonate corrects it. It is useful in diseases like **white scour** of calves and where acidic fermentation is suspected to be going on.

If given with calomel, soda bicarb prevents the occurrence of some of the disagreeable effects of it, and is, therefore, always used with calomel whenever given internally.

In **rheumatism** it serves to bring down acidosis of the system and should be continued till the urine becomes alkaline.

Dose :—½ to 2 ounces.

1344. SODIUM SULPHATE

Glauber's salt.

Sodium sulphate occurs in large, transparent crystals. It is easily soluble in water. Occasionally on absorption of a little moisture from the atmosphere, it dissolves in its own water of crystalisation.

It is a saline purgative just like magnesium sulphate or Epsom salt and the doses are the same. It has an advantage over magnesium sulphate in use in case of jaundice.

For repeated use in case of jaundice it is to be used in fractional doses of 4 to 8 ounces, repeated thrice or four times daily or less, according to the condition of the animal.

Dose :—1 to 2 pounds.

1345. SILVER NITRATE

It is an **antiseptic** and **astringent** when used internally. But it is rarely used as such. Externally it combines with the organic matter of the skin or the membranes and forms a protective deposit of metallic silver in black form. In **catarrhs** or in **stomatitis** the ulcerated surfaces are treated by touching with a swab, dipped in silver nitrate solution of 20 grains to the ounce. For removing excessive granulations, silver nitrate paint or better touching with a silver nitrate stick is useful.

1346. SULPHAPYRIDINE : M. B. 693

It is one of the sulphonamides lately brought into use in chemotherapy. It is found to be a highly

powerful bactericide. Its action may be bacteriostatic, i.e., for stopping the further growth of bacteria. It may kill the bacteria, and finally it may destroy the toxic action produced by the bacteria.

Administered orally it is absorbed by the system within a few hours of administration. It circulates in the blood partly free and partly combined, and is quickly excreted through the urine.

As it is eliminated through the kidneys its therapeutic activities are most marked there. It is, therefore, the most powerful urinary disinfectant. It may deposit as crystals in the renal tract. Therefore, it is advisable to follow it up by large doses of alkali and the free intake of water.

Where the infection is intense, oral administration may be insufficient, and then it may be introduced intra-muscularly in its soluble form, obtainable in ampoules.

In human therapy, it has taken a distinct place in fighting various cocci infections. In pneumonia or meningitis it cuts the attack short if administered in the early stages. In gonorrhœa of men it has now taken the place of a specific.

In veterinary practice in **pneumonia, meningitis,** in **anthrax** or **pleurisy** and **metritis** it is used with highly satisfactory results. In fact, wherever there is a chance of cocci infection, dosing with sulphapyridine (or sulphanyl amide) prevents infection.

In cases of **delayed placenta** or on other similar occasions when the hand has to be introduced into

the uterus, the operation should be followed up by the administration of sulphapyridine.

Human dose is 4 tablets of 1 gram each, every 6 hours to a total of 60 grams. But one-fourth of this dose is found to be effective in most cases. In veterinary practice 10 to 20 tablets per dose are to be given on the first day, which is reduced on the second and third days.

1347. TARTAR EMETIC

Antimony Potassium Tartrate.

It occurs in white powder or minute crystals and has a metallic sweetish taste. Solubility in water 1: 12.

It is an efficient expectorant. It is useful when there is hard cough and little secretion in bronchitis.

It has great value as an emetic, although rather slow in action in impaction of rumen. It has a remarkable toxic action on the trypanosome parasite of blood and is, therefore, used intravenously in surra. It is an irritant and toxic to the skin. In intravenous injection, care should be taken that nothing goes subcutaneously as it is sure to cause ulceration.

Tartar emetic is effective in nasal schistosomiasis or nasal granuloma. Intravenous injections of 25 to 40 c.c. of 3 per cent solution is given every other day for a period of 15 to 25 days. The solution should be freshly made and sterilised by boiling for a short time.

Does :—Expectorant ½ to 1 dram
Emetic 2 to 4 drams.

For intravenous injection use 3 per cent solution 5 c.c. per 100 lbs. of body weight.

1348. THYMOL

Thymol occurs in large colourless crystals. It has a sweet, pungent odour. It can be obtained from the volatile oil of Ajowan (Ptychotis). It is slightly soluble in water. It is an **antiseptic, germicide** and **vermicide.** Its action is like that of carbolic acid, but it is much less irritant and less toxic. As germicide it is useful in **influenza** and **nasal catarrhs.** Dissolved in oil and sprayed with the help of an atomiser it gives relief in **rhinites** and laryngitis. As an intestinal disinfectant it is useful in **coccidiosis.** As a vermicide it has a definite place in the treatment of coccidiosis, and can be used as a general intestinal disinfectant. Thymol is used in killing hookworms and has a good anthelmintic action.

Dose, (for internal) :—¼ to 2 drams dissolved in oil arachis and emulsified with water, in which case it has to be followed by a purgative.

On account of its irritating action upon the skin, it is used as a constituent for **liniments** in combination with turpentine and camphor.

For use as a counter irritant :—

Thymol	...	10
Camphor	...	5
Turpentine	...	25
Oil Arachis to	...	100

For antiseptic wash :—

Thymol	...	4 grains
Borax	...	24 ,,
Soda Bicarb	...	40 ,,
Water to	...	1 lb.

1349. TOBACCO

Tobacco contains the toxic alkaloid nicotine. Tobacoo leaves in powder, therefore, can be used as a germicide and parasiticide. Its use as a parasiticide is taken advantage of in employing it for getting the cattle rid of the **mites** as well of the ticks and the larvæ of the warble fly.

The alkaloid in the tobacco can be released by boiling it with water in which lime is added. This solution may be used after straining. Nicotine is dissolved out of tobacco by digestion with kerosene also. This is usefully employed for spraying on the cattle for the ticks. The extract in kerosene may be strengthened by the addition of some carbolic acid and turpentine.

The following is an efficient insecticide with tobacco as basis.

Tobacco powder	...	8 oz.
Kerosene oil	...	10 lb.

Put powdered tobacco in kerosene. Mix. Shake once or twice daily for a week. Strain through cloth and mix :

Turpentine	...	4 oz.
Oil lemon grass	...	1 oz.
Acid carbolic	...	1 oz.

Tobacco has proved to be very useful in hump sores. Tobacco in fine powder is mixed with an equal weight of litharge, and the mixture is worked up into an ointment with vaseline or a thin medium like cocoanut oil.

1350. TRYPAN BLUE : TRYPAFLAVIN : METHYLENE BLUE

Trypan Blue is a dye-stuff and is an antiseptic and analgesic. It is used with good result in **piroplasmosis** of the cattle. Various doses are recommended, and the mean is about 1·5 grains per 100 lbs. of body weight in 100 c.c. of normal saline. It is injected by the intervenous route. If the fluid escapes into subcutaneous tissues, it causes suppuration and necrosis. Trypan Blue is a specific in **Tick fever**. **Trypaflavin** is recommended as a superior preparation. It has the same injurious action as Trypan Blue on subcutaneos tissues. Its dose is the same as that of Trypan Blue.

Methylene blue is antiseptic and analgesic. It is eliminated through urine and milk. Some practitioners use it for **mastitis** for this purpose. It is used in **Johne's Disease** in 6 grain doses dissolved in 3 to 4 ounces of water 5 times daily for 5 consecutive days and then repeated.

1351. UROTROPIN : HEXAMINE

Methenamine. Hexamethylene tetramine.

Urotropin is produced by the action of ammonia upon formaldehyde. Its use depends upon the ease with which it is converted to formaldehyde in the system. It itself produces no systematic action. It appears within a few minutes after administration in the urine. It has little action on alkaline urine. The practice is to make the urine acid by the previous administration of acid sodium phosphate. Some doubt the ability of acid phosphate to make urine

acid in the cattle. The acid phosphate is incompatible with urotropin, and the two drugs, therefore, should be given separately.

It is used in nephritis and white scour, acting in both cases as internal antiseptic.

Dose :—$1\frac{1}{2}$ dram to 3 drams.

1352. VASAKA : ADHATODA VASAKA

Dried Vasaka Leaves.

Hind.—Arusha. *Guj.*—Adulso. *Tamil*—Adhatodai.

Vasaka has a considerable reputation all over India as an **expectorant, anti-spasmodic** and is largely prescribed in chest affections attended with **cough** and hectic fever. The ancients were full of praise for the virtues of Vasaka and the most modern experiments confirm that the praise bestowed on it was not undeserved.

Vasaka contains an active principle Vasicine which has a slight but persistent broncho-dilatory effect produced by the depression of the nerves of the heart, lungs etc. It liquefies sputum, makes it easy to come out. It also relieves **bronchial** spasm. Vasaka contains an essential oil which has antiseptic properties, and that also helpfully acts on the system.

Dose :—$\frac{1}{2}$ to 1 ounce. Use in powder form, boiled in water.

1353. ZINC OXIDE

It is a white or yellowish white, tasteless powder, insoluble in water, obtained by burning zinc metal.

Zinc oxide has astringent and antiseptic properties. Externally it is a desiccant and is used in eczema as a dusting powder or as an ointment. As a dusting powder it may be used by itself or mixed with starch in any proportion. For ointment 10 to 20 per cent of oxide is used in a vehicle of paraffin. It is very useful as a dressing for burns and scratches and eczema. In moist eczema it serves to absorb moisture, and keep the surface dry and sweet when sprinkled as a dusting powder.

CHAPTER XXXVI

DRUGS AND DISEASES : THEIR APPLICATION—TREATMENT AND TEST

1354. LIST OF REMEDIES AND THEIR APPLICATION

(**1303**). Acid Arsenious.

A stimulant and tonic. Useful in Anæmia, Surra. Used for criminal poisoning.

(**1304**). Acid Boric and Borax.

Antiseptic, used in Nasal Catarrh, Rhinitis, Laryngeal Catarrh, Milk Fever, Eczema, Dermatitis and Stomatitis.

(**1305**). Acid Carbolic and Oil Carbolic.

Disinfectant, germicide and toxic. Useful in Eczema, Anthrax, Mumps and Tetanus.

(**1306**). Acid Salicylic & Sodium Salicylate. (oil and ointment)

Antiseptic, parasiticide. Useful in Eczema, Acne, Ringworm, Calf Diphtheria, Rheumatism, Arthritis, Pericarditis.

(**1307**). Acid Picric.

Analgesic and antiseptic. Useful in Eczema, burns and Dermatitis.

(**1308**). Aloes.

Purgative. Useful for Peristalsis and for Helminthiasis.

(**1309**). Alum.

Astringent. Useful in Nasal Catarrh, Rhinitis, Laryngeal Catarrh and Bleeding.

(**1310**). Ammon Chloride.

Expectorant. Useful in Bronchitis and Ascitis.

(1311). Arjun.

Cardiac stimulant. Useful in Heart weakness and as diuretic.

(1312). Bismuth Carbonate.

Antacid. Protects mucuous membranes and is antiseptic and astringent. Useful in White Scour, Coccidiosis, Diarrhœa and for dusting in skin diseases, wounds, burns etc.

(1313). Bone Meal.

Supplier of calcium and phosphorus. Useful in Rickets.

(1314). Calcium Carbonate.

Supplier of calcium. Useful in Rickets and is an Antacid.

(1315). Calcium Chloride.

Coagulator of blood. Useful in Bleeding and Ascites and for saline infusion. Also as lotion in urticaria.

(1316). Calcium Gluconate.

Coagulator. Useful in Milk Fever, Bleeding, external or internal.

(1317). Calomel.

Antiseptic, cathartic and bactericide. Useful in Jaundice, Diarrhœa, Dropsy and Roundworm. Externally useful for Eczema.

(1318). Camphor.

Antiseptic, anti-spasmodic, stimulant, insecticide and rubifacient. Useful in Bronchitis, Pleurisy, Colds, Heart weakness, Congestion of Brain, Rheumatism, Vomiting, Peritonitis. Used for embrocations and liniments.

(1319). Catechu.

Astringent. Useful in coccidiosis, Diarrhœa and for checking Peristalsis.

(1320). Charcoal.

Desiccant, absorbent, antiseptic. Useful in Coccidiosis, Gastric Catarrh and external wounds.

(1321). Chloral Hydrate.

Hypnotic and anæsthetic. Useful in Meningitis, Tetanus, Vomiting, for surgical operations and in Prolapses and Colics.

(1322). Copper Sulphate.

Astringent, caustic, vermicide, emetic, powerful anthelmintic. Useful in Laryngeal Catarrh, Bronchitis, as emetic, in Anæmia due to want of copper and in Helminthiasis, also for washing off sloughs from wounds.

(1323). Creosote.

Antiseptic, expectorant, analgesic. Useful in Couprous Pneumonia.

(1324). Ferrous Sulphate.

Astringent. Useful in Johne's Disease, Diarrhœa, and Anæmia.

(1325). Iodine Tincture and Lugol's solution.

Antiseptic, germicide, disinfectant. Useful in Acne, Calf Diphtheria, Mumps. Specific in Actinomycosis.

(1326). Iodoform.

Antiseptic. Useful in Metritis, Retained placenta and in dressing of wounds.

(1327). Kamala.

Parasiticide. Useful for Helminthiasis.

(1328). Kaolin.

Absorbent. Useful in Gastric Catarrh, Diarrhœa, Dysentery.

(1329). Magnesium Sulphate.

Cathartic, Useful in Pericarditis, Dengu, Intestinal colic, Jaundice and Tetanus.

(1330). Myrobalan.

Astringent. Aperient and anthelmintic. Useful as Purgative for worms, in Palpitation and in flatulence.

(1331). Neem Leaves.

Antiseptic. Useful for poultice and for washing wounds as lotion.

(1332). Novocain.

Anæsthetic. Useful through injection for local anæsthesia and in Tetanus.

(1333). Nux Vomica & Strychnine.

Tonic, nerve and circulatory stimulant. Useful in Paralysis, Constipation and in respiratory trouble.

(1334). Oil Castor.

Cathartic. Useful in White Scour, Gastric Catarrh, Calf Diarrhœa.

(1335). Oil Chaulmoogra.

Parasiticide. Useful in Johne's Disease.

(1336). Oil Turpentine.

Antiseptic, vermicide, styptic and rubifacient. Useful in Bleeding, Rheumatism, Intestinal colic, Lice.

(1337). Opium & Morphine.

Hypnotic and sedative. Useful in Pleurisy, Gastric catarrh, Peritonitis and all colics and shocks.

(1338). Papaya Milk.

Anthelmintic, bactericide. Useful in Eczema and Skin diseases, Ringworm and Diphtheria.

(1339). Potassium Iodide.

Alterative and Expectorant, Absorbent. Useful in Bronchitis Meningitis, Mumps, Peritonitis and Actinomycosis.

(1340). Potash Permanganate.

Antiseptic, deodorant. Useful in Metritis, Calf Diphtheria.

(1341). Punarnava.

Diuretic. Useful in Ascites.

(1342). Saline (For infusion).

Bleeding, Tick Fever.

(1343). Sodium Bicarbonate.

Antacid, solvent of exudates. Useful in Rhinitis, Nephritis, White Scour. In Burns, Eczema, as dressing.

(1344). Sodium Sulphate.

Cathartic. Useful in Jaundice.

(1345). Silver Nitrate.

Antiseptic, Astringent and Caustic. Useful for giving protective coating in stomatitis, Catarrhs, Ulcers.

(1346). Sulphapyridine : M. B. 693.

Bactericide. Useful in Pneumonia, Meningitis and other cocci infections. Also as internal antiseptic.

(1347). Tartar Emetic.

Expectorant, emetic and Parasiticide. Useful in Laryngeal Catarrh, Bronchitis, Surra, Nasal Granuloma.

(1348). Thymol.

Antiseptic, anthelmintic and rubifacient. Useful in Nasal Catarrh, Rhinitis, Laryngeal Catarrh, Coccidiosis.

(1349). Tobacco.

Parasiticide and antiseptic. Useful in Mange, Warble fly.

(1350). Trypan Blue. Trypaflavin. Methylene Blue.

Antiseptic and Analgesic. Useful in Tick Fever, Johne's Disease.

(1351). Urotropin. : Hexamine.

Internal antiseptic. Nephritis. White Scour.

(1352). Vasaka.

Expectorant, anti-spasmodic. Bronchitis. Cough, Hectic Fever.

(1353). Zinc Oxide.

Desiccant, astringent, antiseptic. Useful in Eczema, Worts and Skin Diseases.

1355. LIST OF DISEASES AND THEIR REMEDIES, TREATMENT AND TEST

Infectious and Contagious Diseases

(1384). Rinderpest.

Inoculation with attenuated virus and injection of anti-serum and serum simultaneous.

(1385). Hæmorrhagic Septicæmia.

Serum simultaneous.

(1386). Black Quarter.

Serum and Vaccine.

(1387). Anthrax.

Anti-serum. Carbolic acid 1 dram dose in gruel. Sulphapyridine.

(1388). Foot and Mouth Disease.

Frequent antiseptic washes. Neem lotion.

(1389). Three Day Fever : Dengu.

Mag. Sulph—½ lb. doses.

(1390). Cow Pox.

Neem lotion wash.

(1391). Contagious Pleuro-Pneumonia.

Organic arsenic preparations.

(1392). Tuberculosis.

Tuberculin test, Double intradermal test, Healthy surroundings, Nature-cure.

(1393). Johne's Disease or Para Tuberculosis.

Johnin test, Mineral deficiency making up, Healthy surroundings. For Diarrhoea : astringent, Ferrous Sulphate and Sulphuric acid. Methylene Blue 30 grains for 5 days by mouth. Chaulmoogra injection.

(1394). Actinomycosis.

Surgical, Picking out, Necrosis, Arsenic bougie, Iodine injection. Iodinine intravenous 5% 200 c.c.

(1395). Bang's Disease.

Mineral feeding. Preventive measures.

(1396). Tick Fever.

Trypan Blue 1½ to 3 grains in 1 to 5% solution per 200 lb. body-weight, intravenous injection. Repeat 6 hours. Trypaflavin 15 grains in 50 c.c. normal saline, intravenously is better. Normal saline in case of weakness. Ferrous sulphate 1 to 2 drams daily for anæmia. Aperients in constipation.

(1397). Surra.

Tartar Emetic 3% solution 5 c.c. per 100 lb. intravenous. Arsenic up to 7 grains twice daily.

(1398). Tetanus.

Anti-serum intravenous 50 to 100 c. c. Carbolic acid 1 dram water 2 oz. every 2 hours, inject subcutaneously. 36 drams may be introduced in 24 hours. Chloral Hydrate 1 to 2 oz. per rectum. Morphine 3 to 4 grains subcutaneously. Novocain 1% 50 c.c. intra-spinal. Mag. sulph, subcutaneous injection ½ oz. in 50 c.c. water per injection. Salvarsan after 100 c.c. Calcium Chloride injection. Soda Bicarb 8% 500 to 1500 c.c. intravenously.

(1399). Rabies.

Pasteur treatment, Anti-serum.

(1400). White Scour : Septicæmia Neonatorum.

Castor oil emulsion 1 to 2 drams. Soda Bicarb, Bismuth Carb, Hexamine 1 dram each with gruel.

(1401). Navel Ill : Septecæmia of the New-born.

Prevent by use of Iodine on navel, Polyvalent Anti-Streptococcus serum for prevention.

(1402). Calf Diphtheria.

Lugol's solution paint. Potash Chlorate wash. Permanganate wash. Salicylic acid paint. Papaya milk 1 to 3% solution in glycerine, paint for throat.

(1403). Coccidiosis.

Astringents, Disinfectants. Bismuth Subnitrate 1½ oz. with Charcoal 250 grains to be sprinkled on the tongue. Catechu 2 to 3 cubes, Thymol 15 grains in water or gruel daily.

Diseases caused by worm Parasites

(1404). Helminthiasis.

Copper Sulphate 1% solution 3 to 10 oz. by mouth, Kamala ½ to 1 oz. in gruel by mouth. Tobacco powder 1% infusion 100 to 300 c.c., Myrobalan 8 oz, Aloes.

(1410). Nasal Granuloma or Nasal Schistosomiosis.

Intravenous injection of Sodium Antimony Tartarate.

Diseases of the Mouth

(1417). Stomatitis.

Wash with salt 1 oz. and water 4 lb. Mouth wash of Thymol 10 grain, Borax 1 dram water 1 lb. cathartics.

(1418-19). Stomatitis in Suckling and Salivation.

Borax desiccated mixed with honey for pasting.

(1420). Mumps : Parotitis.

Carbolic acid 1 to 2% compress. Iodine ointment. Iodine intravenous. Potash Iodide internally.

(1421). Obstruction of Œsophagus.

Mechanical and surgical.

Diseases of the Stomach and Intestine

(1422). Vomiting.

Camphor 1½ dram in gruel. Chloral Hydrate 1 oz. doses in gruel.

(1423). Tympanitis.

Mechanical and surgical treatment.

(1424). Foreign body in the Stomach.

Mechanical and surgical treatment.

(1425). Gastric Catarrh.

Castor oil for evacuation. Thymol in ½ dram doses for disinfection. Wood charcoal in 8 oz. doses, suspended in water. Kaolin 8 oz. Astringents, Opium in 1 dram doses. Lime water.

(1426). Intestinal Colic.

For severe pain, Morphine 2½ to 4 grains subcutaneous, Turpentine oil in 1 oz. doses mixed with some bland oil, followed by Mag. Sulph in 1 lb. doses.

(1427). Chronic Intestinal Catarrh.

Purgatives, astringents, dimulcents, removal of parasites.

Diseases of the Liver

(1428). Jaundice.

Calomel in fractional doses of 4 grains and Soda Sulph 8 oz. regular daily use.

(1429). Gall Stone.

Morphine 2½ to 4 grains injection in severe pain. Aperients, Castor oil, Mag. Sulph.

Diseases of the Peritoneum

(1430). Ascites.

Punarnava 3 oz. dry or 2½ lb. green, Calcium Chloride 2 to 4 drams. Magnesium Sulphate. Withdrawal of fluid by puncture.

(1431). Peritonitis.

Camphor 1 oz. in oil 4 oz. inject intra-peritonially, Opium 1 dram by mouth, Potash Iodide 1 to 2 drams. Aperients for constipation.

Diseases of the Nose

(1432). Nasal Catarrh.

Alum, Boric acid, Borax as lotion in 1% solution. Thymol in oil 1% strength, spray.

(1433). Croupous Rhintitis.

Same as in Nasal Catarrh. Soda Bicarb 1 to 2% as lotion for dissolving pseudo membranes.

Diseases of the Larynx, Bronchi and Lungs

(1434). Laryngeal Catarrh.

Same as in Nasal Catarrh. Silver Nitrate 1% solution paint. For internal use for throwing off pseudo membranes copper sulphate 2 to 7 grains doses in water or Tartar Emetic 2 to 7 grains doses in water.

(1435). Bronchitis.

Demulcents, anti-spasmodic, expectorants, Vasaka electuary 2 oz. dry leaf per dose. Ammon Chloride 2 to 4 drams, Potash Iodide 1 to 2 drams. Tartar Emetic and Copper Sulphate as in Larygeal Catarrh, Camphor 1 dram as electuary.

(1436). Infectious Bronchitis.

Same as in Bronchitis. Morphine ¼ to 2 grains injection for severe cough, Milk injection 40 to 60 c. c. subcutaneously.

(1437). Pneumonia : Croupous Pneumonia.

Inhalation creosote lotion 2 to 3% 50 c. c., Sulphapyridine. Antiphlogistin, Embrocation, Counter irritant.

(1438). Catarrhal Pneumonia or Broncho Pneumonia.

As in Croupous Pneumonia.

(1439). Fibrous Pneumonia.

Sulphapyridine as antiseptic.

(1440). Pleurisy.

Counter inritant, Poultice, Camphor liniment, Sedative Opium. Sulphapyridine.

Diseases of the Heart

(1441). Pericarditis.

Soda Salicylas 4 drams, Myrobalan 8 oz. repeated twice. Aloes 1½ ounce. Mag. Sulph 1 lb. doses.

(1442). Myocarditis.

Rest, Nursing. Arjun. Strychnine.

(1443). Valvular Disease

Rest, Nursing. Cardiac tonics like Arjun.

(1444). Palpitation.

Sedative, Morphia, Chloral Hydrate or Pot. Bromide injection in 20 to 40 grains doses.

(1445). Brady Cardia.

Rest.

(1446). Irregular Heart.

Cautious work. Arjun.

(1447). Heart Weakness.

Arjun 2 oz. × 3 doses. Camphor in oil injection. In constipation, Mag. Sulph.

Diseases of the Kidney

(1448). Nephritis.

Soda Bicarb ½ oz. doses. Potash Nitrate 2 drams. Punarnava, dry, 4 oz. daily.

(1449). Pyelonephritis.

Urotropin 1½ dram. Sulphapyridine.

Diseases of the Blood

(1450). Anæmia and Bleeding.

Milk injection 20 c. c., Calcium Chloride in ½ oz. dose, Alum, Turpentine. Saline, normal, subcutaneous 5 to 10 pints. Copper in dahi, Arsenious acid 2 grains doses.

Diseases of the Brain

(1451). Concussion of Brain.

Rest. Non-interference.

(1452). Congestion of Brain.

Inject Strychnine ¾ grain, Camphor in oil 15% ½ to 1 oz.

(1453). Sun Stroke.

Cold Compress on head. Sponging.

(1454). Meningitis.

Potash Iodide 2 to 3 drams, Embrocation, Lumber puncture. Chloral Hydrate inject intravenously 10 grains in 100 c. c.

(1455). Milk Fever.

Calcium Gluconate 2 oz., Boric acid 3 drams, Water 14 ounces mix, sterilise, inject subcutaneously. Pumping air through the teats.

(1456). Tetany.

Alkali Carbonate, Calcium Phosphate, Sedatives.

Diseases of the Skin

(1457). Urticaria.

Aperients. Calcium Chloride in normal saline.

(1458). Eczema.

Carbolic oil 5%, Boric Powder 10%, Salicylic oil 5%, Zinc Oxide 5%, Picric lotion 1%, Papaya 1 to 5% solution. Salicylic acid dry powder diluted 50% with Boric acid. Milk 20 c.c, inject subcutaneously.

(1459). Dermatitis.

Boric Ointment 10%, Picric acid 1%.

(1460). Gangrene of Skin.

Antiseptic Dressing.

(1461). Acne.

Tincture Iodine, Acid Salicylic Ointment 5%, Soda Bicarb solution, rub for cleaning.

(1462). Ringworm.

Acid Salicylic Ointment 10%, Milk of lime 5%, Soda Bicarb $2\frac{1}{2}$% wash.

(1463). Mange.

Tobacco 10% decoction in lime.

(1464). Ticks.

Common Salt, Tobacco decoction paint.

(1465). Lice.

Turpentine.

(1466). Warble Flies.

Saturated salt solution, Derris Powder, Tobacco 4 lb., water 4 lb., lime 1 lb. mix, strain, apply.

(1467) Hump Sore.

Tobacco leaves powder 1 part, Litharge 1 part, make paste with cocoanut oil for application.

Deficiency Diseases

(1468). Rickets.

Calcium Carbonate. Bone Meal.

(1469). Osteomalacia.

Same as in Rickets.

Constitutional Diseases

(1470). Paralysis.

Nux Vomica, Laxatives. Massage, Embrocation.

(1471). Rheumatic Arthritis.

Soda Salicylas, inject subcutaneously 20 grains in 10 c. c., Camphor Turpentine liniment.

Female Diseases

(1472). Mastitis.

Anodyne, Antiphlogistin, Sulphapyridine. Polyvalent strepto Vaccine.

(1473). Metritis.

Permanganate 1 : 2000, Iodoform pessary. Sulphapyridine. Polyvalent strepto vaccine injection.

THE COW IN INDIA

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PART—VII

DISEASES AND THEIR TREATMENT

INTERNAL ORGANS OF THE COW

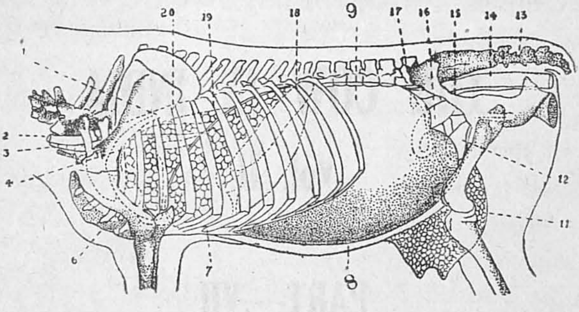


Fig. 101.

1. Aorta ; 2. Œsophagus ; 3. Trachea ; 4. Pulmonary artery ; 6. Heart ; 7. Reticulum ; 8. & 9. Rumen ; 11. Udder ; 12. Urinary bladder ; 13. Vagina ; 14. Rectum ; 15. Ureter ; 16. Uterus ; 17. Left ovary ; 18. Spleen ; 20. Posterior vena cava.

INTRODUCTORY

TO PART VII

The treatment of cows suffering from disease is a subject of great importance. There was a system of medicine prevalent in the villages of India for treating the ordinary maladies, but knowledge of such treatment has been dying out and the Western system of medicine has not been able to step into its place in the village. Although much is now known by scientists about the diseases of the cow, of their prevention and of their treatment, yet very little of such knowledge has filtered down to the villagers. For diseases of men, a large number of physicians are maintained by the people. Apart from Government employment, private individual and family requirements maintain the medical men for the services they render. Although for every two persons there is one head of cattle, roughly 200 millions of cattle to 400 millions people, the practice of maintaining veterinarians by private individuals has not yet sprung up. The Veterinary Service is entirely maintained by the Government or public bodies like Municipalities and District Boards. Private practitioners are rare. This state of things is responsible for much preventible suffering amongst the cattle. Although these keep much better health normally than human beings, yet they too suffer from diseases. Fever, penumonia, dysentery, diarrhœa,

tuberculosis, para-tuberculosis, take their toll. Surgical cases often occur; wounds, cuts, burns, blisters, ulcers and sores, fractures and dislocations are rarely attended to properly; these do cause a lot of suffering, and some diseases like arthritis make the animals occasionally useless. All these can be attended to by persons having an ordinary measure of knowledge about diseases and their treatment. Some of the diseases from which the cattle suffer are practically common between them and human beings. In the case of indigestion or diarrhœa, in case of external and internal parasites, of external ticks and mites, and in surgical cases, the treatment is practically the same as for human beings, and the medicines are the same; variations only have to be made in doses and an eye has to be kept on the difference due to the structure of the digestive organs. A man who knows how to deal with the diseases of men can very easily adjust his knowledge to its being of use to the cattle also. Therefore, there is much scope of work for treating the ordinary ailments of the cow, armed with a knowledge of the character which our village doctors should possess.

Contagious Diseases

In the case of the cattle, apart from the diseases or the various organs working in the body, there is a very important class of diseases of infective and contagious nature. Their importance overshadows the importance of all other diseases put together. When epidemics occur they carry away thousands of

animals. Cases of death from epidemic diseases and endemic diseases are much greater in number than they are reported to the Veterinary Department. Yet, even with such fragmentary information, the mortality recorded from contagious diseases mounts up to 2½ to 3 lakhs annually in British India alone. With the States included, the total mortality from epidemic will range from 4 to 4½ lakhs every year. Of this total, one disease only, rinderpest, carries away half the number. Other infectious diseases, next in importance to rinderpest, are hæmorrhagic septicæmia, black quarter, anthrax and foot-and-mouth diseases. The proportions of mortality from these diseases to the total mortality from contagious diseases in 1937-'38 were as under :

Total mortality from contagious diseases—2,36,177.

Mortality from			Per cent.
Rinderpest	...	...	49·1
Hæmorrhagic Septicæmia		...	22·6
Black Quarter	...	...	8·2
Anthrax	...	...	4·4
Other contagious diseases		...	15·7

Total mortality—100 per cent.

There is the foot-and-mouth disease, the mortality from which is small. Of the affected cattle only 4 or 5 per cent die. But this disease ruins the constitution of the animals, and those that survive take a long time to come back to their previous state of health. Many of them are incapacitated for work. The economic

loss through foot and mouth disease is enormous. The contagious character of this disease is surpassingly powerful.

The mortality and economic loss from the contagious diseases, therefore, stand by themselves. It is proposed to deal with these diseases first, and then take up the other diseases and their treatment systematically. Before taking up the treatment of diseases, a chapter (Chap. 37), on the examination of the diseased animals and diagnosis is given. The first thing for the veterinarian would be to know how to examine the animal and where to look for the cause of a particular disease. In the chapter next to that, (Chap. 38) the general character of these diseases and the principles of immunity and isolation are dealt with as a preliminary to taking up the contagious diseases.

After dealing with the contagious diseases, the diseases of the various organs are taken up one by one, and they form the subject matter of a subsequent chapters.

Difficult labour and minor surgery are finally treated, with a closing chapter on general information and glossary.

CHAPTER XXXVII

EXAMINATION OF THE OX AND DIAGNOSIS OF DISEASES

1356. NECESSITY OF CORRECT DIAGNOSIS

A correct diagnosis is necessary as a preliminary to the treatment of diseases. The changes in the body and the changes in the condition of the organs, external signs, attitude in general, attitude towards food, character of the excreta and exudations and other symptoms have to be studied. From their study a conclusion has to be arrived at regarding the recognition and the name of the disease. In the following pages some simple methods of examination are given so that those readers who may not have observed disease symptoms before, far less know the diseases, may have an idea of these. For this purpose, the names of a few diseases and their most prominent symptoms are given in brief along with a description of the method of examination of the organs. Greater details are given in the systematic treatment of diseases. Only a few symptoms are mentioned here as a preliminary to familiarise the reader with some of the characteristics of the diseases or the seats of some of the diseases.

1357. DIAGNOSIS BY INSPECTION

Diagnosis is to be arrived at by a study of the symptoms of the disease, by an examination of the diseased organ and by a study of the character of the disease.

To proceed systematically, the condition of the animal should be ascertained by questioning the owner or keeper of the animal. Questions should be directed towards ascertaining—

(1) The date of commencement of the disease.
(2) The symptoms that were observed indicative of the disease.
(3) The known cause, if any, of the disease.
(4) How the animal got ill.
(5) Whether several animals were suffering from the disease, pointing to a common cause, such as infection, poisoning etc.
(6) The medicines or treatments for the disease given to the animal previously.

On receipt of replies to these questions, the veterinarian will be able to form some idea about what is wrong with the animal, and he shall then proceed to examine it.

The first point of examination should be inspection. Without touching the animal, if it is a full-sized animal, the examiner may go round and observe whether the different parts of the body appear normal and note any abnormalities. To guide such inspection the following points regarding the regions of the body have to be rememberd: (1) Head, (2) Neck, (3) Chest, (4) Abdomen, (5) Pelvis, (6) Extremities.

(1) **Head** is divided into (a) face and (b) forehead.

(*a*) *Face* :

1. Region of the nose,
2. Region of the lips,
3. Region of the mouth,
4. Region of the eye,
5. Region of the maxilla and inter-maxillary space.

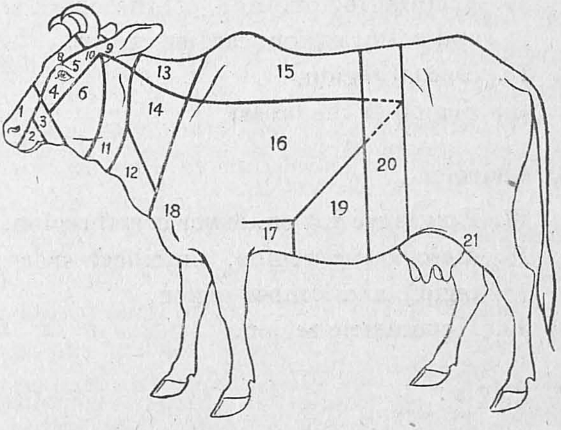


Fig. 102. Regions of the body.

1. Region of nose ; 2. Region of lips ; 3. Region of mouth ; 4. Region of eye ; 5. Region of maxilla ; 6. Masseteric region ; 8. Frontal region ; 9. Occipital region ; 10. Temporal region ; 11. Parotid region ; 12. Tracheal region ; 13. Cervical region ; 14. Lateral cervical region ; 15. Region of withers ; 16. Pectoral region ; 17. Sternal region ; 18. Region of breast ; 19. Epigastric region ; 20. Mesogastric region ; 21. Hypogastric region.

(*b*) *Forehead* :

6. Frontal region,
7. Occipital region,
8. Temporal region.

(2) **Neck** :

9. Parotid region,
10. Tracheal region,
11. Cervical region,
12. Lateral cervical or sides of the neck.

(3) **Chest** :

13. Withers,
14. Pectoral region, side of the chest, scapula and costal region, cardiac region,
15. Sternal region,
16. Region of the breast.

(4) **Abdomen** :

17. Epigastric region, lower costal region,
18. Mesogastric region, umbilical space, iliac region, and lumbar region,
19. Hypogastric region.

(5) **Pelvis** :

20. The region of the croup, the hip, the anal region, the pubic and inguinal region.

(6) **Extremities** :

Anterior limb : Shoulder, point of shoulder, arm, elbow, forearm, knee, cannon, fetlock joint, pastern, coronet, bulb of heels, hoof.

Posterior limb : Thigh, stifle, leg, hock, hind cannon.

These parts are described in **Part V.—The Body the Cow.**

1358. DIAGNOSIS BY PALPATION, PERCUSSION AND AUSCULTATION

After having had a general observation of the animal, the next step is to examine it by (1) **Palpation**, (2) **Percussion**, (3) **Auscultation**.

1. **Palpation** : Palpation consists in feeling the part to be examined with the fingers. This gives information of the affected part regarding its temperature, sensitiveness, abnormalities, amount and nature of swelling, if any. The examination may reveal whether a part is doughy—soft and yielding to pressure and retaining the pressure for some moments as happens in œdema, in which the serum gets accumulated.

The part may be firm, it may be hard like bone or it may be soft and fluctuating. When pressure undulates a part, it indicates the presence of fluids such as pus or blood or serum.

The part may show a puffy swelling which crackles and shifts, as it happens, due to the presence of gas in the tissues or emphysema, as in the case of Black Quarter.

2. **Percussion** : Percussion is the examination by striking the part and feeling the sound produced by the vibration set up.

The percussion sound will often give information about the condition of the organ percussed. The differences in sound are well marked.

For this purpose the index or the middle finger of the left hand is placed over the part and struck sharply with the middle finger of the right hand. The

striking should come down vertically and should be stiff. The left hand finger or fingers should be in close and intimate contact with the body. If there is any space left between the finger and the body, the examination will not give a correct indication. According to the area of examination both fore and middle fingers may be laid on the part. The striking may be done by the tips of the right fore and middle fingers jointly. The left hand fingers are shifted from point to point over the area and struck, and the sound observed.

When the striking is to be heavy, a hammer (plexor) may be used. With lean animals light strokes may do, while fat animals require more force in striking. Usually two or three strokes at a point brings out the character of the sound. Care is to be taken that the animal does not get frightened and nervous. It should be quieted by speaking to.

The character of percussion sounds : When the stroke is on a solid airless part of the body, the sound given off is flat, or of short duration and of little intensity. The sound is called *dull* or *flat*.

While if an air-containig organ like the lung is under the surface, the sound is of considerable intensity, duration and tone. The sound is called *resonant*. The stronger is the percussion the fuller is the sound. When the over-lying tissue is thinner, the lung tissue will vibrate the more. When the volume of the air-containing organ is small at the point, there will be less intensive sound.

The resonant sound is characteristic of the condition of the organ. The resonant sounds are judged by their character which are grouped as under:

(1) *Tympanic* : The sound is like a musical sound and uniform.

(2) *Full* : When the sound is not uniform and lacks the musical quality of the tympanic resonance.

These resonant sounds may gradually merge into a dull sound by degrees, and are characterised as dull resonant which then by degrees fall or become absolutely dull.

The 'full' sound is found over a normal lung. The air in the alveoli, the lung tissue and in the thoracic walls vibrate.

When the cavity percussed has connection with outside air as in the trachea, the sound is tympanic and hollow. When the sound comes from caverns in the lung communicating with the bronchii, the sound is tympanic. The pitch depends upon the size of the cavern and or the communication of the opening.

The tympanic sound is obtained on percussion over air-containing cavities like that of the stomach or bowels.

When the lung tissue containing air is surrounded by solidified portions, as in the case of tumour of the lungs, the tympanic sound is heard.

An amphoric or metallic note, such as is produced by a vibrating sheet of metal, is observed in the pneumo-thorax or from the smooth-walled pulmonary caverns as in the resolving stage of croupous

pneumonia. Cracked pot sound comes from open pulmonary caverns, or in the pneumo-thorax.

3. **Auscultation** : Auscultation is the examination of sound by putting the ear on the part by which the condition of the deep-lying organs may be apprehended. This is performed on the heart, the lungs and the gastro-intestinal tracts. The binural stethoscope can be employed for this purpose. Applying the ear directly on the organ gives better results than can be obtained by the use of instruments. The ear should be applied firmly.

1359. DIAGNOSIS FROM THE ASPECT

Examination of the general or external aspect or attitude of the patient :

An insight into the disease can be obtained by observation of the attitude, the condition and the conformation of the body of the patient.

For example, the head is held stiffly and in an extended position in the following diseases—pharyngitis, tetanus, muscular rheumatism, etc.

When the animals are very sick they hold their heads down, and remain in a relaxed, languid attitude, with ears drooping. When cows suffer from inflammation of the vagina, they hold their tail high and urinate frequently with legs spread apart. This attitude can be easily understood by a little observation.

When there is pain in the chest and the abdominal wall, which is increased by movement, the animal remains stiff and quiet.

When there is pneumonia and pleurisy, the animals keep standing. In lying down they always lie on the affected side, because the pressure of the body against the ground somewhat relieves the pain.

In colic pain animals lie down and roll and again stand up in restlessness. They look at the flanks. When a cow is approaching the time of parturition she becomes restless, sits down, changes position, paces to and fro, and something like the symptoms of colic appear. Difficulty of breathing, restlessness, and anxious moving about takes place.

Gait : In severe fever the gait is slow and laboured. The gait becomes stiff in tetanus and muscular rheumatism etc. Lameness in the calves is seen in Black Quarter or Blackleg. In Foot and Mouth Disease lameness is seen in one or more limbs and also in arthritis.

Lying Posture : Sometimes the animal is unable to rise. There may be different reasons. Once it fails to rise it is difficult to make it do so. Sometimes it so happens that out of obstinacy the ox refuses to get up, specially if it had been lying down for sometime. When animals are suffering from severe pain in the legs and feet or when they are lying on an injured limb they fail to get up. In colic also when down, it is difficult for the animal to get up promptly.

In tetanus the animal may be unable to rise without help. When recumbent, the upper pair of legs do not come in contact with the ground. In tetanus the animal may be restless and sweating.

In paralysis the animal is unable to rise when the vertebral column is affected. In post-partum or ante-partum paralysis, cows are unable to rise. In milk fever the cow lies in a comatose condition, as if in profound sleep, the head resting against the chest. If the head is lifted up and released, it drops back to the former position. In meningitis, the neck becomes stiff and wry, paralysis may follow. The patient lies flat on its side with head drawn back.

In articular arthritis, or rheumatism of joint, there is a sudden swelling which is hot and painful. If several joints are affected the patient keeps lying down. There is fever with high temperature, no appetite and cessation of rumination.

1360. DIAGNOSIS FROM THE CONDITION OF SKIN

The condition of the skin often indicates the state of health. In normal condition the hair on the skin is fine and glossy.

The hair becomes erect due to chill. In many infectious diseases the animal gets a staring coat.

Shedding of hair : In cattle there is shedding of hair before winter when a soft winter coat appears. In the beginning of spring this is shed. Mal-nutrition interferes with this seasonal shedding of hair. Hairs may fall off after recovery from a severe illness.

Sweating of skin : There is always some invisible sweating going on. In exercise sweating becomes visible. In case of dyspnœa there is profuse sweating. This is a compensatory action to throw off excretal

matter. In severe attacks of septicæmia there is sweating.

Swellings under the skin : These swellings greatly help the identification of diseases. Œdema of the skin is due to the accumulation of serum in the connective tissues under the skin. This may be due to dropsy and also to inflammation which is usually localised.

The swelling may be due to emphysema of the skin in which gas accumulates in the tissues and causes crackling sounds on pressure, as in Black Quarter.

Rash may appear on the skin which is due to a swelling of the papillary body.

Vesicles are elevations of the epidermis of the skin due to an accumulation of fluid. These are of small size, the size of a pea. The larger vesicles are called blisters. Vesicles rise in foot-and-mouth disease and in pox. When the vesicles of pox dry up, pox marks are left which are contracted vesicles. When the vesicles are filled with pus, they are called pustules. When the upper corium layer is destroyed, and a purulent surface of wound is exposed, it is called ulcer. When epidermic flakes are loosened out, it is called scurf. When a mass of exudate dries on the skin it is called a scab.

Prurigo is a papular eruption causing itching.

Urticaria is a swelling of sudden appearance.

Swellings in throat occur in Hæmorrhagic septicæmia.

Eruptions on skin occur in Rinderpest also.

1360A. EXAMINATION OF THE EYE

Discharge from the eye indicates disease In Keratomalacia discharges take place, so also in rinderpest and catarrhal fever. The colour of the conjunctiva changes and becomes yellow in jaundice.

Swelling of the conjunctiva occurs in rinderpest and anthrax, etc.

1361. EXAMINATION OF THE BODY TEMPERATURE

A clinical thermometer is to be used. The thermometer is to be inserted into the rectum, practically the whole of its length. The determination of body temperature is of great importance in the diagnosis of diseases. When there is an outbreak of infectious diseases, the beginning of an attack may be detected before other symptoms appear by the taking of temperature once daily. The normal temperature of the oxen is, according to some authorities, 100·5 to 103·1°F. Generally it is found within the range of 101 and 102°F. In pregnant cows the temperature indication is higher by 1·5 degrees F. The temperature rises by rapid exercise. There is a slight daily variation of temperature, the lowest being in the morning and the highest in the evening.

Fever is associated with a rise of temperature. When the temperature rises rapidly, chill and shivering is experienced. Such chill is evidenced in attacks of rinderpest, septicæmia etc.

Temperature becomes subnormal in fatal diseases just before death.

Surface temperature is measured by laying the hand on the ears at its root, in a grip. Deviation from the normal are sometimes more appreciated by the use of hand than by the thermometer. When there are fæces in the rectum, a correct reading is not obtained by the thermometer.

1362. EXAMINATION OF THE PULSE

The pulse is felt on any convenient prominent artery. The most usual part in oxen is the sub-maxillary artery. Other arteries such as the radial or plantar may be used. The coccygeal artery at the root of the tail is also a convenient place. The tail is to be lifted a little and the artery felt. The pulse is felt by pressing the tips of the three middle fingers on the artery while the thumb is held perpendicularly. Vary the pressure, and roll the artery a little to feel the beat. When the pulsations are clear, count with the help of a watch the number of beats per minute.

The oxen have a pulse of between 45 and 55. Large animals show lower or less frequent pulse than the small ones, adults slower than the young, females higher than males, and well-bred individuals show slower pulse than mongrels.

In the oxen, when the pulse goes beyond 100 per minute, say, to 120-150, it denotes severe illness. In all cases the pulse rate does not correspond to the temperature. In cases like septicæmia or anthrax it does so. The beats of the pulse depend upon the reaction of fever upon the heart.

In painful conditions the pulse goes up, such as in severe injuries, fracture of bone, abscess on hoof etc. In mental excitement also the pulse rate goes up.

Pulse is 'weak' or 'strong'. It can be measured from the pressure of the middle finger to overcome it. The strength of the pulse increases after movements. The degree of weakness of the pulse indicates the severity of the illness.

The pulse may be 'hard', or it may be 'soft'. The pulse is hard in severe pain. A pulse is 'trembling' when the wave is so small that a slight trembling is felt. It is 'thready' when it is so weak and soft that it is hardly perceptible.

1363. EXAMINATION OF THE HEART

The heart is felt by placing the palm of the hand in the region of the heart, on the chest wall. The examination is best done with the animal standing. A dull thud will be felt. The beat can best be felt at the fifth inter-costal space, just above the union of the rib with its cartilages.

The heart can be located by percussion because a part of the organ rests against the thoracic wall.

The heart is covered largely by the lungs. Only a relative sound may, therefore, be determined by percussion on the left side at the third and fourth inter-costal space. When there is pleurisy or pericarditis, percussion causes pain to the animal.

Auscultation of the heart : The heart sound may be heard by placing the ear on the left side just

behind the left elbow, the leg being drawn forward. Two tones are heard, the systolic or the first and the diastolic or the second heart sound. The first sound is duller, deeper and more prolonged and usually louder than the second sound, which is not so deep and is at times metallic. By pronouncing the syllable

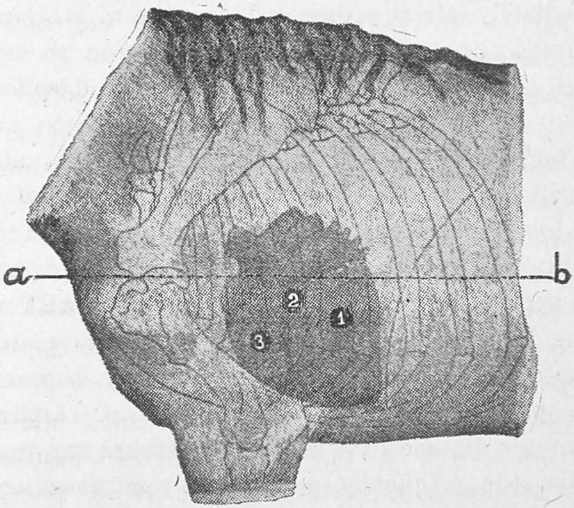


Fig. 103. Diagram showing heart in the bony cage.

a. b. Line of shoulder ; 1. Left auriculoventricular opening ; 2. Portal ; 3. Pulmonary artery.

lub, dub the heart sound can be imitated. It requires long experience to identify the various sounds of the heart in pathological condition and make deductions about the condition of the heart and its diseases.

1364. EXAMINATION OF THE RESPIRATORY ORGANS

The frequency of respiration may be ascertained by counting the rises or falls of the flanks per minute. In the oxen the respiration normally is from 12 to 16 times per minute.

The normal respiration is disturbed by exercise, or immediately after eating. The normal working is disturbed also in disease. When it is due to disease and the number increases, it is called dyspnœa or difficult breathing.

There is a rhythm in respiration. This also is disturbed in disease. The inspiratory movement may last too long because of some obstruction in the respiratory passage. This is inspiratory dyspnœa. The expiratory act may last too long, the relaxation of the diaphragm being not sufficient to complete the expiratory movement. This is expiratory dyspnœa.

A peculiar change in the cycle of respiration occurs in a disease known as **cheyne stokes respiration.** In this, the frequency progressively increases to the point of dyspnœa, then it slowly subsides to a pause, after which the cycle is repeated.

The nostrils are hardly moved during normal respiration and the ribs are slightly raised.

In difficult breathing, when not in exercise, the nostrils dilate. The movements of the ribs become pronounced. There are fewer deep breaths. The breaths are shallower. The volume of respiration is diminished in diseases of the pleura or chest walls, when they become painful. In the respiratory act there

is a rhythmic movement both of the thorax and the abdomen. If breathing is performed principally by the auxiliary muscles of the thorax, it is called 'costal'. This happens when air cannot pass in freely or when the diaphragm and its adjacent organs are diseased. Abdominal tumours, tympanitis may cause this.

On the contrary, when the abdominal muscles are more active than the thoracic muscles, the type of breathing becomes 'abdominal'. This happens when a painful condition of the chest wall is present, and when expiration is difficult.

Abnormal sounds of respiration: When the nasal chamber is narrowed down, due to the growth of a tumour or swelling of the wall of the nostrils or other disorders in the nasal passage or when an exudate deposit is in it, a wheezing or blowing sound emanates from the nostrils.

A rattling or gurgling noise is heard in respiration when the larynx or trachea contains loose masses of mucus. Groaning is heard when a long inspiration is followed by a prolonged, audible respiration. Groaning may come from healthy animals. It is produced by the pressure of the distended abdominal organs upon the diaphragm. This happens after a full feed or when the animal is pregnant.

Nasal discharge: In the ox there is a slight discharge from the nose normally. The ox absorbs it by putting the tongue inside the nostrils. In disease this flow increases. The discharge may come from the mouth or from the pharynx. In catarrhs the discharge is slightly increased. The colour of the

discharge also changes during the course of the disease. Sometimes it is colourless, varying to yellow, red or brown.

Coloured discharges come from serous and mucous catarrhs. If red blood corpuscles are present the colour is yellow or greyish- yellow. Bloody discharge may occur only from injuries or from ulcers or bleeding tumours in the nasal cavities.

In anthrax there may be nasal hæmorrhage.

Cough : The presence of cough in the ox is always abnormal. The character of the cough in the ox is sharp, soft, toneless and prolonged. The ox can be made to cough by pinching the upper trachea or larynx. Cough may be distinguished as painful and painless. The cough may be vigorous or weak, prolonged or short.

1365. EXAMINATION OF THE LUNGS

Examination by Percussion

The different sounds obtained by percussion have been described. In percussion of the lungs a tympanic tone is heard when a portion of the lung is more or less surrounded by solid tissues or exudate, which isolate the portion from its environment. This is obtained in the beginning and the last stages of fibrous pneumonia, in catarrhal pneumonia and in the presence of tumours which may surround the lung containing air, and if large caverns are present in pneumo-thorax. A cracked pot sound is obtained when a cavern containing air is in direct communication with the bronchus. When a dull sound is

heard in place of the normal resonant sounds, the indication is of disease.

Examination by Auscultation

For examination the ox is taken out of the stall and made to come back quickly. This exercise brings out the sounds more clearly, because of deeper respiration.

Auscultation of the thorax over a healthy lung gives a soft, sipping sound which is called vesicular or alveolar murmur. This sound is like that when 'v' is pronounced softly. This sound begins with inspiration and increases as the inspiration continues and resolves into a shorter, fainter sound during expiration, having the character of the sound coming out on softly aspirating 'f'. This murmur is very soft and feeble.

The vesicular murmur is exaggerated in intensified respiration of dyspnœa. In compensatory or forced work of one lung, when the other is not functioning as in pneumo-thorax, the vesicular sound is exaggerated.

When bronchitis sets in and the air passages are constricted, then also the vesicular murmur is exaggerated. On the contrary, when the thoracic wall is thickened by the accumulation of fat or from disease, the vesicular murmur becomes diminished or more feeble.

Bronchial tones : Bronchial tones are normally obtained in the trachea or in the larynx. When this bronchial sound emanates from the lungs it indicates

a diseased condition. When the vesicles are filled with exudate as in pneumonia, the bronchial sound is given off. If in pleurisy, the lungs are pressed by the exudate in the pleura, the bronchial sound appears.

Bronchial respiration may assume an 'amphoric' character when the sound approaches the note given out by gently blowing across the mouth of a narrow-mouthed bottle. This happens when there are large caverns in the lungs, communicating with the bronchi.

Rales or rhonchi are heard when the bronchi or the caverns in the lung contain movable exudate through which air is forced.

Pleuritic sounds : In normal working the lungs glide against the pleura and there is no sound. But in pleurisy a pleuritic friction sound is obtained on auscultation, sounds produced as in rubbing or cracking.

Some diseases of the respiratory apparatus that may be revealed by the examinations are :

1. *Bleeding from the nose* : Nasal Catarrh. In this there is congestion of the nasal mucuous or serous membranes, accompanied by nasal discharge.

2. *Laryngeal catarrh* : Cough is present, at first dry and painful, later on moist.

3. *Paralysis of the larynx* : Sudden appearance of acute inspiratory dyspnœa.

4. *Bronchial catarrh* : It may be detected when the disease is advanced, accompanied by fever, quick pulse rate and dyspnœa in an acute stage. In the chronic stage there is no fever when short, dull, weak cough is perceived. Sudden and severe dyspnœa may

indicate **pulmonary congestion**, the respiration exceeds 100 per minute with foamy, serous nasal discharge.

5. *Broncho-pneumonia* : This may begin as catarrhal bronchitis, later developing into broncho-pneumonia, with high fever and painful cough. The vesicular murmur becomes feeble.

6. *Pleurisy* : The respiration becomes accelerated and dyspnœic. A friction sound is heard on auscultation in the early stages. But later on with much exudation accumulating, the friction sound becomes unperceivable.

7. *Tuberculosis* : Only very advanced cases may be diagnosed when the lung is highly affected. Cough is always present, vesicular murmur is exaggerated, rales sounds are obtained.

1366. OBSERVATION OF DRINKING & EATING

Thirst is increased in various diseases. Animals with fever want to sip slight quantities of water frequently. During the crisis of influenza there is more urination and more thirst. In diarrhœa when much fluid stool is passed there is greater thirst. Thirst decreases in colics, in gastric and intestinal affections generally. Refusal of water for long periods is an unfavourable sign. Mastication becomes abnormal when there is injury in the lining of the mouth or defect in the teeth.

Inflammation in pharynx causes difficulty of deglutition. Any attempt to swallow food is attended with pain, as manifested by extending the head or the neck, and in shaking the head.

When there is paralysis of the pharynx, in tumours of the pharynx, in actinomycosis, there is difficulty of swallowing. Inflammatory conditions within the mouth cause salivation and foaming at the mouth.

1367. EXAMINATION OF THE MOUTH

The temperature of the mouth is raised during fever and in local inflammation of the mucous membrane. Secretion of saliva decreases in all acute febrile diseases and colic and other intestinal affections. It is because of this that animals cease to take food during illness.

Nodules, pustules and ulcers appear in the mouth in stomatitis and several other diseases. There may be injury to the tongue from foreign bodies. The condition of teeth may interfere with deglutition. It should be noted that the incisors of all ruminants are loose. Sharp points in the molars cause defective mastication. These can be felt by passing the finger over them.

Actinomycosis renders the tongue hard and knotty. The pharynx may swell in pharyngitis. Swelling and inflammation of the pharynx may be caused by abscesses. In paralysis of the palate the animal cannot swallow fluid or soft solids which come out through the nostrils. In complete paralysis of pharynx the animal is unable to eat. In any attempt to do so regurgitation through the nostrils takes place.

Rumination may become abnormal due to disease. Normally there are 60 masticatory movements per

minute before the cud is re-swallowed. The act of rumination after a feed requires about two hours, and the cattle prefer to be in a recumbent position to ruminate.

Rumination is disturbed in febrile diseases. The reduction in the number of cuds per minute gives an indication of abnormality. Rumination may cease altogether. This happens in fevers, and in other severe diseases and in surgical diseases. Over-loading of the paunch and gastric diseases also cause cessation of rumination. Belching takes place in the cattle involuntarily. By this the gastric gases pass out through the oral or nasal openings. Belching is normally associated with rumination in cattle.

Quickly fermenting fodder may obstruct the opening of the cap of the paunch and may make belching impossible or insufficient, leading to excessive accumulation of gas or bloating. Vomiting is a symptom of disease and may be due to the presence of foreign bodies at the base of the tongue or at the pharynx. It also occurs in obstruction of the œsophagus. Intestinal affections and irritation of the mucous membrane of the stomach may cause vomiting. Chronic vomiting may arise from obstruction in the œsophagus, hernia of the diaphragm, or constriction of the pylorus etc. It is an unfavourable symptom.

1368. EXAMINATION OF THE ABDOMEN

The size of the abdomen may be normal or abnormal for the breed and the feed. The size

differs in breeds, and also according to the nature of the feed.

Pregnancy causes enlargement of the abdomen. It is generally apparent on the posterior third and more on the right than on the left. The fœtus when large can be determined by palpation from outside, as also its size.

By the accumulation of food in the stomach it can be distended. In such cases the normal tympanic tone is replaced by a dull tone.

In tympanitis the distension is in the upward direction. The hollow of the flank gets filled up and the walls become distended.

Tumours in abdomen, spleen and liver may cause distension.

Examination by Palpation

The abdomen may be palpated to determine whether there is a painful condition existing and also to determine the condition of the consistency of the bowels. The entire hand is put on the abdomen and the palpation is performed from the wrist in mild pushes following one another at brief intervals.

The contents of the abdomen, if it is soft solid, as it should be, disappear on peristalsis in about 1¼ minutes. If this peristalsis does not occur then there is obstruction or the paunch is unable to work. When the abdomen contains much fluid, it makes, on palpation, a splashing sound and creates a wave-like motion.

Hernia may cause abnormality in the abdomen.

Examination by Auscultation

The various movements of the solids, liquids and gases can be observed by auscultation. The intensity of sound represents the intensity of the bowel movement. If auscultation is performed on the left thoracic wall immediately behind the pulmonary margin at the lower end of the sixth and seventh ribs, the sound of contraction is heard at brief intervals. The absence of sound does not absolutely indicate inactivity of the organ. Generally, however, some indication is obtained of the condition of working.

Accumulations, obstructions and tympanitis, indicating stasis, cause decrease of sounds. Sounds are diminished in permanent diarrhœa and in severe inflammations. In cases of irritation the sounds are loud. In gaseous distensions a ringing sound may be heard.

1369. EXAMINATION OF THE FÆCES

When fæces are dry and hard, defecation becomes difficult. When there is a painful, inflammatory condition in the abdominal cavity, defecation becomes painful. Cattle defecate 10 to 12 times daily. When the normal frequency is reduced, it is called constipation. The term diarrhœa is used when evacuations are abnormally frequent and consist of liquid or semi-solid fæces. In well-fed cattle the daily quantity defecated may rise as high as 90 pounds. The ingesta remain in the tract for 1½ to 4 days.

The longer the ingesta remain in the intestine the darker they become. The colour changes from a

shade of green when fed on green stuff to various lighter and darker shades according to the quality of the food. Concentrates tend to give them a greyish character.

When there is less than normal flow of bile, the stool is coloured grey or clayish. Blood may get mixed when the colour tends to become red, brownish red, or of chocolate colour. Blood from intestines discharged after a time often gives a black colour. When blood is thoroughly mixed with the fæces, it indicates bleeding in the intestinal tract. If the bleeding occurs in the rectum some blood adheres to the fæces in the form of streaks or clots.

In the dysentery of calves the fæces are grey or greyish white. There is a thin coating of mucus on normal fæces which gives it a shiny coat. When there is excessive mucus, it appears glossy. The peculiar odour of the dung of the ox is varied and becomes foul when putrefactive processes go on in the digestive tract. Fæces may contain ova, or parasites like ascarides or liver flukes etc. Microscopic examination may reveal them.

Some diseases of the digestive tract

Stomatitis : The change can be observed on the tongue, and the mucous membrane of the mouth from catarrh, vesicles or ulcers.

Actinomycosis : Tumour-like growths appear on the tongue, lower maxilla and pharynx.

Pharingitis : Inflammation of pharynx. Fever is present. The head is held up and the neck is stiff.

Mastication and deglutition is impaired. Fluid is ejected through the nose in attempts at swallowing.

Paralysis of œsophagus : Difficulty of deglutition is present without inflammatory symptoms.

Foreign bodies in œsophagus : The œsophagus can be examined by the speculum. Salivation, inability to swallow and chocking are present. There is tympanitis. The saliva may flow from the nose.

Acute tympanitis : Bloating can be found by inspection. The abdomen is distended. There is difficulty of breathing and defecation is retarded.

Acute dyspepsia : Stomach refuses to work. There is no appetite. Peristalsis is incomplete. The flank is sunken.

Acute gastrointestinal catarrh : Fever is present with frequent pulse ; other symptoms like dyspepsia also appear.

Dislocation of bowel : It occurs suddenly and without cause. The animals lie down, kick their bellies and get up again ; feeding and rumination cease. By palpation through rectum the obstruction may be located.

Of the **infectious diseases** having their location in the digestive tract the most severe is Rinderpest. There are high temperatures. Difficulty of respiration, and constipation at first which gives place to severe diarrhœa. Discharges come from the nose and the eyes. There is great depression and general weakness. Diarrhœa and dysentery are some of the other intestinal diseases.

CHAPTER XXXVIII

INFECTION, IMMUNITY, ISOLATION AND DISINFECTION

1370. WHAT IS INFECTION?

Infection is the process by which a disease is transmitted from animal to animal. The diseases so transmissible are called infectious. Some substance carrying the disease, in such cases, is transmitted to the subject causing the disease. Generally a very small quantity of disease-creating substance, on transference, reproduces larger quantities of the disease-creating substance in the transmitted animal. These disease-creating substances are micro-organisms or are of a bacterial nature. Some are so small that they elude the microscope and are called ultra-visible **viruses.**

The infective agents may be transmitted to a healthy animal by direct or indirect contact. The disease is then called a contagious one. In indirect contact, various agents may carry the contagion, or serve as carriers. Contact infection or contagion may take place through the common attendants, through the eating and drinking vessels, through bedding, harnesses, walls, through soil or through herbage, through other animals—who may not be affected by the disease themselves, but who may simply act as carriers. Contagion may come through streams,

through roads and paths ; and strong currents of air may carry the contagion through to some distance.

The disease-producing organisms, germs or bacteria may be classified into two groups : (1) Those that live and can draw their nourishment from some living body or host. These are known as **parasites.** (2) Those that draw their nourishment from dead organic matter are called '**saprophytes**'. Those organisms that depend entirely for their existence on hosts, can be easily dealt with. If the hosts are destroyed the disease germs become extinct. But not so the saprophytes, which may continue to live in the saprophytic condition. Rinderpest is successfully exterminated in some countries by killing the hosts or diseased animals. The offending microbe cannot live long outside the host.

1371. NATURE OF THE MICRO-ORGANISMS

The micro-organisms vary very much in shape and size. Some of them are like rods and are called **bacilli,** some are round in shape and are called **cocci** ; others have a spiral or a cork-screw shape and are named **spirilla.** Some have filaments. Those having branched filaments are known as **caldothrix.** Bacteria is a common name for all these micro-organisms. Bacteria are very minute bodies. Their size vary from $\frac{1}{5000}$th of an inch to $\frac{1}{25000}$th of an inch. Usually bacteria when magnified 1,000 times appear $\frac{1}{20}$th of an inch size, whereas under 2,000 magnification they look about $\frac{1}{10}$th of an inch in size. Their measurement is expressed in microns which is about $\frac{1}{25000}$th of an inch. Some bacteria are very much smaller than the

above sizes. They cannot be distinguished even under the highest power of microscope. They are called ultra-visible viruses. The virus of rinderpest, foot-and-mouth disease, cow-pox and rabies are of this description. They cannot be seen, and cannot, therefore, be measured. They pass through the pores of the finest porcelain filters.

The bacteria are classed as the lowest order in plant life, while there are others called protozoa which are claimed as belonging to the lowest order in the animal kingdom. In the vegetable kingdom also these micro-organisms are divided as belonging to the moulds or yeast groups. Moulds may be found growing on any damp surface which offers sufficient nutriment. There are others which thrive on animal body and give rise to diseases. Hæmorrhagic septicæmia, anthrax and black quarter—three very important and fatal of cattle diseases—are due to bacteria belonging to the fungi group.

The bacteria are differentiated by their method of propagation and growth. Propagation may take place by fission and by spore formation. Fission is the term applied for transverse division into two parts. The organism elongates and then the middle part becomes thinner and thinner and finally the two parts separate. When the organisms are spherical or cocci, they may divide irregularly and form clusters like grapes. They are called 'staphylococci'; when they remain in a chain like beads they are called 'streptococci'. When the division of cocci takes place in one plane, 'diplococci' are formed. They are found

in pairs. When the division takes place in two planes tetra-cocci are formed.

Spore formation takes place in two ways—by endogenous spores, and by arthrospores. The micro-organisms are one-celled organisms or protoplasms surrounded by a skin or membrane. In the formation of spores a round, highly refractile body develops in the protoplasm of the micro-organism. This is the spore. The enclosing case breaks away and the spore becomes free. In the arthrospores the entire protoplasm becomes converted into a spore, so that one organism gives rise to one spore only. The spores develop great resistance to environments and may lie in a quiescent stage for a long time till favourable conditions for multiplication present themselves. The spores of anthrax need particular mention. The spore of anthrax lives on for years ; it may resist boiling temperature even for a short time, and has been found under ordinary conditions to retain its vitality for 12 to 18 years and then when suitable conditions for growth appear, it is converted into bacillus form. With anthrax, the bacillus can form a spore only in the presence of oxygen, so that if the body of an animal, dying of anthrax, is not opened and buried deep, then in the absence of oxygen spores cannot form. Whereas, if blood or body fluids of animals dying of anthrax is exposed to air, the bacilli develop spores. The spores may remain in the soil indefinitely, but on receiving a rainfall they germinate and infect the grass, and animals eating that grass may get infected. These bacilli, after

germination and multiplication, may again sporulate so that the soil infection is indefinitely kept up and disseminated.

Some of the bacteria possess the power of locomotion and are called motile. Their motility may be observed under the microscope. They have a delicate whip-like process which they lash backwards and forwards and propel the body. The whip-like processes are called flagellæ. The movement is called flagellate movement.

Bacteria multiply with great rapidity if circumstances favourable to their growth are present, namely, suitable temperature, atmosphere and food. Yet the multiplication cannot indefinitely go on. By their very life process they produce toxic substances which after a time inhibit their growth in that medium.

Bacteria require salts, carbon and nitrogen for their growth. Plants secure carbon from the atmospheric carbon dioxide, with the help of chlorophyll. But bacteria have no chlorophyll. Therefore, for their purpose they secure carbon from organic matter, such as sugar. They get their nitrogen from nitrogenous compounds such as albuminoids. Inorganic materials, such as ammonia and nitrates, also may be used by some organisms for their nitrogen supply.

Some require oxygen for their growth, as has been mentioned about the anthrax bacilli. Such ones are called aerobic. Others can live in the absence of oxygen only. These are called anaerobic ; a third category of these may live in the presence or absence of oxygen.

The proper temperatures of growth for bacteria differ. Generally speaking the pathogenic bacteria, or those that produce disease, require the body temperature of animals for their growth. Light is unfavourable to their growth and some of them die on exposure to diffused light for sometime, and some die in a very short time under direct sunlight. Chemical poisons kill them. Those that draw their nourishment from some living body or the body of their 'hosts' are called parasites.

1372. THE CHARACTER OF BACTERIA

Bacteria are studied for their appearance and multiplying capacity under the microscope where, with the help of a mechanical stage, their number in a volume can be counted. Some of them take up a particular dye, others take up another sort of dye. By the help of these dyes their appearance stands out prominently under the microscope. Their behaviour with dyes allow them to be classified and ultimately identified.

Artificial growing of culture : Bacteria can be made to grow under artificial conditions for study and also for multiplication, when their multiplication is necessary for use in the treatment of diseases as also for laboratory purposes. Different media are used for inducing such growth according to the character of the bacteria. The common media are broth, agar, potato, gelatin, blood serum, milk etc. Methods of obtaining pure culture have been devised which allow the investigator to pick up the particular bacilli he wants, and multiply them.

The method pursued generally is to take culture tubes or test tubes, fill them partly with a nutrient medium and plug them with cotton wool and sterilise them in steam for half an hour daily, successively for three days. By this operation any bacteria or their spores that may have got into the medium die. Now is obtained a pure bacteria-free nutrient medium in which is put a little of the substance containing the bacteria to be cultured with the help of a sterile platinum needle. The tube is plugged and kept at 37°C. temperature for 2 or 3 days. After this period, an examination will show that colonies have appeared, which are visible to the eye. Such colonies may contain a variety of mixed bacteria whose separation is done with the help of differential treatment under varying temperature. Some die and some out-live particular temperatures. Dilution of the substance from a colony also offers means for studying separately and differentiating. Inoculation of the culture in an animal also serves to separate them by taking advantage of different rates of growth in a living animal, and through the appearance of a particular disease due to the bacteria under examination.

1373. RESULTS OF INFECTION

Bacteria, when they enter into the body of a host, may cause mischief in more than one way. They may cause injury by abstracting nourishment from the blood and changing its character, and they may by their excessive multiplication choke the capillary blood vessels. They may injure by secreting or

excreting poisonous chemical substances or toxins. This last way is the main cause of the harm that they do in creating diseases.

The toxins get absorbed in the system and by their circulation cause the characteristic diseases.

Bacteria may find entrance into an animal body or 'infect' an animal through wounds, as in rabies and tetanus, by inhalation as in influenza, by ingestion with food materials as in rinderpest, foot-and-mouth diseases, or through bites of insects such as in surra, tick fever etc.

1374. IMMUNITY

Immunity is the ability of an animal to resist infection. The resistance offered may be against the organisms or the toxins which they create.

Natural Immunity : Some animals are naturally immune to some diseases to which other species are subject. Thus 'strangles', a disease of the horse, will not affect an ox, and rinderpest or foot-and-mouth diseases of the cattle will not affect human beings. These species are immune against those bacteria. These are examples of natural immunity.

An acquired Immunity : Immunity may be acquired and the method of imparting acquired immunity comes to be classed as the preventive treatment of diseases. In some cases one attack of the disease renders the subject immune for the rest of its life. This is the case with rinderpest. An animal which has survived an attack of the rinderpest is not attacked again in life. The vaccination of human

beings against small-pox is an instance of imparting acquired immunity.

Subjects which are amenable to attacks of pathogenic bacteria are called 'susceptible' to these diseases. Susceptibility varies with individuals. The younger animals are more susceptible to attack.

Healthy animals offer more resistance than weak and run-down animals. Susceptibility depends also upon the manner in which infectives enter the system.

Acquired immunity may last a long time or it may be transient. When the immunity conferred lasts life-long or for a year or more, it is called **active** immunity. While, if the immunity conferred lasts only a few fays it is called **passive** immunity. Both have their utility in the evolution of measures of protection against infective diseases.

1375. ACTIVE IMMUNITY

It is conferred in some cases by a previous attack of the diseases, as has been mentioned in the case of rinderpest, or variola (cow-pox). Active immunity may be conferred by (1) inoculation of pure virus (2) inoculation of attenuated virus. If an animal is dosed with a small dose of pure virus, such inoculation will induce the disease represented by the virus. The disease may be slight or it may be fatal. If it is slight, there is use for it in preventive therapy. But if it is fatal, there is no use for it. It has, however, been observed that if an attenuated virus is introduced into an animal, the reaction or the disease created is mild. It serves the purpose of

protection without endangering the life of the animal, if the disease is of such a nature that after one attack the animal is immune for some considerable time. The introduction of an attenuated virus into an animal system in order to induce a mild attack of the disease is taken recourse to in those cases where one attack prevents or retards future attacks. But there are other uses of the attenuated viruses also.

Virus may be attenuated or made less virulent or less potent than its normal state by the following processes.

(1) By heating the virus.
(2) By passing it through other animals.
(3) By the addition of chemical agents.
(4) By unknown causes occurring in the bodies of sick or recovered animals, etc.

An attenuated virus is called a vaccine. Vaccine treatment gives active immunity. Passive immunity may be conferred by inoculation with the blood serum of an animal in which active immunity has been artificially introduced. The immunity conferred by serum is of very short duration. It may allow a herd to pass through a period of outbreak of the infectious disease. Sometimes it may be necessary to introduce serum to pass through the period, as in the case of rinderpest, every 10 days during the period of outbreak.

Sera are useful as curative agents and form the basis of modern serum therapy. But here we are dealing not with the treatment of diseases but with the imparting of immunity or securing prevention. The

reaction of the serum may be directed towards the toxins of the disease germs or against the germs themselves. When it is used against germs it is utilised for securing passive immunity ; when it is used against toxins, it is utilised for treatment. The combined purpose also may be served of fighting both the germs and the toxins.

1376. THE PRINCIPLE OF SERUM THERAPY

Disease-creating bacteria, on gaining entrance into the animal body, multiply and continue to create toxins. But the body does not remain an idle spectator to the dangerous process going on. In its endeavour to outlive the attack the system creates anti-bodies or anti-toxins. These anti-bodies are what may be called neutralisers to the toxins. By coming in contact with the toxins, they neutralise them. This action can be demonstrated outside the animal body even. If a toxin is mixed with an anti-toxin in a tube, then this "toxin—anti-toxin" becomes a harmless substance, and if injected into an animal, is not likely to create toxic-effect, if the quantities were regulated.

When an animal, say, a horse or a bull, is inoculated with an attenuated virus, the animal can outlive the attack. Such an animal then becomes capable of resisting a higher dose of bacterial toxin. This process may be stepped up by degrees till the animal is able to withstand the inoculation not only of a fatal dose of toxin but many times the fatal dose of it. By this process the animal becomes artificially hyper-immunised. What is of significance is that an

animal immunised against many times the fatal dose of a toxin or hyper-immunised, develops anti-toxins in its blood serum which gave it the acquired immunity. If the blood of such an animal is withdrawn and allowed to clot, the serum is found to be loaded with anti-bodies. This serum may now be introduced into other animals either for treatment against that disease or for giving a passive protection against the disease. These anti-bodies in the serum do not stay for a long time in the system, and after doing the work of curing, they either get killed or in the case of use for immunity they pass off through excreta after a time, when the conferred immunity also passes off.

A horse or a bull can be bled for its serum, and after good nourishment it is able to deliver again another quantity. This may continue, if proper care be taken of the horse. Several pounds of blood may be taken at a time for producing the anti-toxic serum of the trade.

When the serum is obtained by inoculating an animal with one strain only of a particular organism, it is called monovalent serum. When different strains of the same species of microbe are introduced, the serum is called 'polyvalent'.

The immunity imparted from the serum is attributed to the phagocytes which act as policemen in the blood and travel to the danger-point and fight the invading bacteria and kill them or produces anti-toxic substances which render the toxins inert. But there remains a gap in this theory of "phagocytosis" which

is filled up by the "opsonic" theory. This theory says that phagocytes are in themselves unable to pick up and destroy micro-organisms. Before phagocytosis takes place, the micro-organisms are acted on or prepared by certain constituents of the body fluids which are called "opsonins", or "feast preparers" (feast for the phagocytes in eating the bacteria).

Resistance to disease is rated according to the opsonic index or opsonic value. It is called high when it can impart immunity and low when it enables a disease to be contracted.

During immunisation by vaccine the opsonic index is lowered for the first few days, and then increased. It remains in a high position for varying periods of immunity. Upon this basis, it is cautioned that an animal, the oposonic index of which is temporarily reduced by inoculation with vaccine, should not be exposed to infection.

This phenomenon accounts for another fact. If a vaccine or attenuated virus is introduced into an animal in which the disease germ has already gained entrance, this new introduction aggravates the infection and causes fatality. In case of suspicion, therefore, a method is employed for injection of serum and vaccine, one after another. If there was infection from before, the serum will help to create a healing influence, and upon the field so prepared, when the period of serum immunity is over, a vaccine is introduced for active immunity. The serum gives immediate protection from the moment of its inoculation.

1377. THE BACTERIOPHAGE

When the stool of a man suffering from bacillary dysentery is taken and emulsified in broth and then filtered, a substance with a peculiar property is obtained. If the filtered matter is introduced into a culture of dysentery bacillus in broth and is incubated for 24 hours at proper temperature (37°C.) the dysentery bacilli are destroyed and the broth which was turbid on account of the presence of the bacilli becomes clear. Now, if this clear substance, so produced, is taken, it is found to have many times intensified the property of the original fluid obtained from the broth of the excreta.

The filtrate of fæces, therefore, contains something which is capable of killing those bacilli. "Bacteriophage" is the name given to this filtrate or substance reproduced and intensified from the filtrate.

The 'bacteriophage' is considered to be a living body, as living as the bacteria themselves, which it kills. It is supposed to multiply at the expense of the living bacteria.

Bacteriophage can be preserved for long periods at ordinary temperature in sealed tubes. It has been used satisfactorily in the bacillary dysentery of lambs and in hæmorrhagic septicæmia of buffaloes.

It is claimed that D'Herrille, one of the originators of bacteriophage, successfully immunised buffaloes in Indo-China, and it appears that the focus of the disease in Indo-China has been stamped out. Bacteriophage is introduced through the mouth.

1378. ANAPHYLAXIS

When an animal is inoculated with the serum of another species, there is no evident harm. But if the injection is repeated within 12 days' time, serious illness or sudden death may ensue. Different animals respond differently to anaphylaxis. Man is only slightly susceptible to anaphylaxis. Anaphylaxis includes serum, milk, albumen etc. It creates under certain circumstances a supersensitiveness to foreign albuminous materials, such materials being in themselves non-toxic. The supersensitiveness can be demonstrated as under :

If a Guinea pig is subcutaneously given a sensitising minute dose of normal horse serum of $\frac{1}{100}$ c.c., and in 12 days' time 5 c.c. more of the same serum is given intraperitonially, very severe reactions appear immediately. The respiration becomes laboured, the heart's action becomes weak, temperature falls, urine and fæces are excreted and a state of collapse approaches. Death also may occur. Rabbits are much less susceptible than Guinea pigs. With an anaphylactic animal serious symptoms may be avoided by making the second dose of serum a small one, and then giving increasing doses.

1379. METHODS OF USING SERA AND VACCINE

Vaccines (antigens) : By injection of vaccine, immunity develops after a few days, during which time a reaction takes place. During the reaction period there is increased susceptibility to the disease. The immunity given is strong and may last several years.

The effect gradually diminishes as time passes on. In places where disease has not broken out already, a vaccine alone is usually given to give protection. This is because of the period of increased susceptibility and also on account of the time necessary for developing immunity.

Serum (anti-serum): By inoculation with anti-sera protection is given immediately without reaction. There is no period of increased susceptibility. The disadvantage of this method is that the protection given is very temporary, lasting only 10 to 14 days.

1380. PROTECTIVE METHODS IN VACCINE AND SERUM THERAPY

The methods of protection of healthy animals against future attacks vary according to the disease. The general principles are described below:

1. **Vaccine (antigen) alone**: This is followed in a locality where a disease is expected but which has not yet arrived.

2. **Anti-serum alone**: This is used where it is desirable to create a ring of immune animals around a centre of infection in order to limit the spread of the disease. Infection, in its course, coming to the serum-protected area, stops and cannot proceed to further regions in that direction. This is sometimes done in order to check the spread of foot-and-mouth disease.

3. **Anti-serum followed by natural contact**: In this method the animals are inoculated with a protective dose of anti-serum, and then are mixed with those that have been suffering from the disease.

Contaminated materials may be brought in contact with the serum-inoculated animals for the same purpose. By this process the animals get an attack of the disease, but the attack becomes mild on account of the protection of the serum. In effect, the animals are given a passive immunity which is converted into active immunity by the mild attack. This method is applicable to diseases which spread by contact, of which rinderpest may be taken as an example. This method used to be applied in rinderpest, but better methods also are now current. This method is of no use in diseases which come through soil infection and not through contact, because it cannot be ensured that bacteria will be picked up from the soil to convert the passive into active immunity. Such soil infection diseases are, for example, tetanus and anthrax.

4. **Double inoculation**: In this method both anti-serum and vaccine are given. Here there is no chance taken of active bacilli being picked up. Serum gives passive immunity, whereas vaccine gives the active immunity. This method varies in a little detail. The two inoculations with serum and vaccine may be done simultaneously or the anti-serum may be given first and the antigen (vaccine) after an interval of time.

The method is also commonly known as the 'serum simultaneous' method. In this vaccine and serum may be drawn into the same syringe and injected. Or, what is more usually done, serum is injected in one shoulder and vaccine on the other.

In other cases, an interval is allowed, as in the case of black quarter. If in a herd there is black quarter

in evidence, then the first thing to do is to protect the rest of the calves by anti-serum injection. After a few days vaccine is injected. In this case also there is difficulty about the interval to be given. If there is a long interval, anti-serum may have spent up itself and vaccine, if virulent, might kill the animal. But these difficulties are disappearing, because attenuated vaccines are now available which, if injected directly, without the protection of serum, do no harm, in case of, say, black quarter. The use of serum in such cases is only to avoid the possibility of endangering the lives of those animals that may have got the disease and were passing through the incubation period without the exhibition of outward symptoms. If the vaccine is given in such cases death will follow. Hence, the use of serum is indicated. If there was already an infection in the animal, serum will act as a curative. After that there will be the occasion for vaccine injection in order to develop active immunity. Anti-serum is also used to check the virulence of the vaccine.

Double inoculation as in 'serum simultaneous' is used in rinderpest and in certain other diseases. When dealing with virulent vaccine, where serum is used to check its virulencc, one has to be careful with the dose of the serum. For, if the dose of serum is smaller than necessary, vaccine may produce severe disease and kill the animal. On the contrary, too much serum may neutralise the vaccine. Methods are being continuously developed to make vaccines safer so as to avoid the risk of killing.

1381. VACCINES AND ANTI-SERA

In India, vaccines and anti-sera for cattle diseases are made in the central depot at Izatnagar, and some of the simpler ones are manufactured at the Provincial Serum Institutes. Below is given a Table of serum and vaccines supplied by the Mukteswar and the Izatagar Institutes : 1940-'41.

Product.	Doses issued during the year.
Rinderpest Serum 'Special' ...	1,26,020
Rinderpest Serum 'Ordinary' ...	5,59,040
Anthrax Serum	70,738
Anthrax Spore Vaccine ...	71,900
Hæmorrhagic Septicæmia Serum	2,64,395
Hæmorrhagic Septicæmia Vaccine	11,91,309
Black Quarter Serum	41,500
Black Quarter Vaccine ...	2,21,650
Mixed Streptococcic Vaccine ...	325
Bovine Abortion Vaccine ...	23
Tuberculin Ordinary	972
Tuberculin Concentrated ...	14,765
Rinderpest Bull Virus	1,855 c.c.
Rinderpest Goat Virus ...	327 ampoules
Rinderpest Goat Tissue Virus ...	2,488 ampoules
Br. Abortus Antigen	1,975 c.c.

—(*Annual Report of Mukteswar & Izatnagar*, 1940-41—P. 63).

Several Provinces in India are manufacturing serum and vaccines to meet their own requirements. The manufacture of Goat tissue vaccine, and Goat blood virus and of anti-sera are the outstanding items of manufacture.

The Bengal Veterinary Department has two vaccine depots for the preparation and distribution of Goat Tissue Vaccine at Calcutta and Chittagong. From these depots 7,609 ampoules, each containing 100 doses of Goat Tissue Vaccine were prepared, being equivalent to over 7 lakh doses, and about 5 lakh animals were inoculated in 1940-'41.

Madras has a Serum Institute in which anti-rinderpest serum, Rinderpest bull virus, Rinderpest goat virus, Dessicated goat spleen vaccine, Anti-hæmorrhagic Septicæmia serum and vaccine, Anti-black quarter serum and vaccine etc. are produced. The Institute used 1322 goats for the manufacture of blood virus during the year 1941-'42. The Institute also used 964 buffaloes and produced 13,95,150 doses of anti-rinderpest serum. Each serum producer yielded on average 1,447 doses of serum.

The United Provinces has a rinderpest vaccine manufacturing centre at Lucknow ; 3,07,025 doses of vaccine were issued from the centre during 1940-'41.

1382. CONTROL OF OUTBREAKS OF CONTAGIOUS AND INFECTIOUS DISEASES

When a contagious disease breaks out the owners of cattle should be careful about watching the temperature of the animals. Even on knowing that an epidemic has broken out in the neighbourhood, it should be the concern of careful stock owners to come in touch with the veterinary officer in the area and arrange for protective measures. Measures by way of inoculation with serum and vaccine are taken by the Government

or District Boards free of charge. These bodies have taken this public duty upon themselves. In the foregoing pages it has been mentioned how lakhs of doses of preventive sera and vaccine are used annually in fighting these preventible infectious diseases. The Civil Veterinary Department of every Province desires to see the Province free of these scourges, and they do whatever can possibly be done. Their endeavours can meet with greater success if the stock owners become acquainted with the Government organisation and come in contact with the officers or stocksmen in their employ in every emergency. There are hospitals managed by District Boards, and to the hospitals are attached Veterinary Assistant Surgeons, some of whom are almost always on tour. The location of these hospitals and the whereabouts of the Veterinary Officers should be known, so that cases of any outbreak may be immediately brought to their notice. As a matter of fact, calls do come to these centres. What is needed is speedy information.

In Western Europe where veterinary arrangements are superior, and there are more men in Government employ to look after the cattle, they have instituted what is known as Veterinary Police service. Enforcement of preventive measures against infectious diseases is one of their duties, and in case of outbreaks of epidemic, what they do is to enforce **'stand still'** measures, particularly with some special diseases as cattle plague, which is another name for rinderpest. Many diseases have been stamped out in Western Europe due to the enforcement of these measures.

1383. STAND STILL MEASURES

It is recommended that affected animals and those in contact should be separated and kept apart. But by itself this step is not enough. By the time some animals show sickness, it is inevitable that they must have spread the contagion to other animals during the preceding days that they were in contact, say, in pastures. There is no means of knowing how many had contacts and are going to be included in the next list of cases. It is, therefore, arranged that in an affected area all cattle movements should be brought to a stand still. In an epidemic the problem is not how to treat the individuals, but how to stop the spread of the disease. The germs of diseases like cattle plague perish in a day or two under the sun. The real danger is from the animals which have been carrying disease in a mild form and affecting others.

It may take time between the breaking out of the epidemic and the arrival of the relief party for giving preventive inoculations. The number of men in the Veterinary Service being very inadequate here, it is rarely possible to take prompt measures. When one area is looked after by a Veterinary Officer another area perhaps has got to wait.

Under these circumstances the best measure for a stock owner is to enforce stand still within the area. When there are many animals in a large establishment the owner has to work in his own interest to bring stand still measures into operation.

A place is to be selected away from the crowded area, and there the actual sick animals have to be kept

separated. In another place those in contact with the sick animals have to be kept separated.

Where individuals cannot possibly take stand still measures it would be wise to immediately improvise a collective arrangement. All sick animals may then be collected together and kept in an area. The stand still measures recommended in Bengal seem to be gaining in favour. The following is from the 1940-'41 Report of the Civil Veterinary Department of Bengal.

> "Several 'Stand Still Camps' for the isolation of cases of contagious and infectious diseases,—specially Rinderpest, were established in various parts of the province and which rendered valuable service as the Veterinary Officers could fall back on these Camps when epidemics broke out or when they became very severe in congested areas, and especially where hygienic measures to stamp out the disease were either difficult or otherwise impossible. On account of such Camps it was practicable to pick up animals infected at once and move them away from others in the village to avoid their being a constant nuisance and a source of danger. These Camps form a system of prevention, which could, as above mentioned, be applied immediately, disease was recognised as existing in a Union by the owners or local inhabitants themselves, without waiting for qualified assistance from the nearest head quarters, or for Sera and Vaccines, required to be ordered from Calcutta. All such gaps of time spent in waiting

for scientific aids, or assistance, could be more usefully taken advantage of by applying promptly and locally the methods of quarantine and segregation by the application of a 'Stand Still' policy to all affected cattle. This means the separation of diseased and suspected, from the healthy in an outbreak, followed by the segregation of the former in the 'Stand Still' Camps;—such was adopted with some degree of rigorous efficiency and the results were encouraging." ...—(P. 4).

As a general measure of safety, stock owners should be circumspect in the purchase of animals from unknown sources. When the source is known, and there is no epidemic disease in that herd, it would be safe to buy the cattle.

But purchases have, as a matter of fact, to be made from unknown sources, from *melas* and fairs. In such cases the purchased animals should be kept separated from the old stock for about a fortnight, so that if any diseases were in an incubation stage, they would come out.

If an animal dies suddenly in the herd, it may be due to accident or poisoning ; but generally it is due to a fatal attack of a contagious disease like hæmorrhagic septicæmia or anthrax, and in cases of calves it may be a case of black quarter.

It would be wise in such cases to proceed upon the supposition that it is a case of severe attack of some infectious disease. The carcass should be disposed of accordingly in the interest of the protection of other individuals in the herd.

Bury the animal deep under earth. Take care in removing the animal to the place of burial. See that no fluid or excreta, coming out of the mouth or anus of the animal, drop on the ground and the paths. The openings of the dead animal should be plugged. It is safe to put a piece of gunny cloth over the mouth and keep it tied so that any dribblings may be caught. The anus should be cleaned and then plugged, and the cleanings burnt in the site.

After putting in the body in a deep dug-out, slash the hide with a knife so that no *chamar* may have any inducement to exhume it for the hide. Cover it up with some lime and then replace the earth. Put some brambles before putting in the last course of earth-filling to prevent jackals from digging out the carcass.

The stall and the standings should be disinfected. Straw should be spread lightly over the surface to be disinfected, and burnt out.

The above course has been sketched out to meet cases of sudden death from unknown causes.

In cases of rinderpest the contaminating materials become innocuous by sunning for 2 days. In every death from contagious disease the ground should be lightly strewn and fired. Refuse materials should be similarly treated.

Carcasses should never be dragged along the ground but should be carried. Articles which cannot be burnt or scalded and require preservation should be treated by boiling in water, like the clothings of attendants. Ropes etc. should be burnt.

CHAPTER XXXIX

INFECTIOUS AND CONTAGIOUS DISEASES

(1384). **Rinderpest** : (1385). **Hæmorrhagic Septicæmia** (1386). **Black Quarter** : (1387). **Anthrax** : (1388). **Foot-and-Mouth Disease** : (1389). **Three Day Fever** : (1390). **Cow-Pox** : (1391). **Contagious Pleuro-Pneumonia** : (1392). **Tuberculosis** : (1393). **Johne's Disease** : (1394). **Actinomycosis** : (1395). **Bang's Disease** : (1396). **Tick Fever** : (1397). **Surra** : (1398). **Tetanus** : (1399). **Rabies** : (1400). **White Scour** : (1401). **Navel Ill** : (1402). **Calf Diphtheria** : (1403). **Coccidiosis.**

1384. RINDERPEST : CATTLE PLAGUE

Synonyms :— **Hindi**—*Pushims* ; **Bengali**—*Gooti, Go-Basanta, Jagadamba, Mata* ; **Gujerati**—*Shili* ; **Kanar.**—*Doddaroga* ; **Malayalam**—*Vasantharogam* ; **Punj.**—*Zahmat* ; **Sind.**—*Sit* ; **Telegu**—*Peddajadyamu.*

Character : Rinderpest is an acute, infective, febrile disease of the cattle, of the nature of typhoid, characterised by sudden invasion and rapid course, high fever, extreme debility, congestion of the mucous membrane of the mouth and the gastrointestinal tracts. The mortality is high. In India it is said to be 25 to 50 per cent ; in European countries the mortality was much higher, being 80 to 100 per cent.

Prevalence: The plains of western Asia and India are regarded as its home. It has now spread all over the world. In Europe there has been a tug of war between the disease and the efforts to eradicate it. It has disappeared from Western Europe, from North America and South America. At the first outbreak in a new country, it sweeps over it from end to end and then dies out, while becoming endemic in certain favourable areas. In Europe and America they have made the disease extinct by killing every affected animal. Repeated operations like this after every outbreak and strict quarantine operations have succeeded in completely stamping out the disease. But it occasionally eludes quarantine. In 1920 a consignment of cattle from India was landed at Antwerp. Some of them died at the local quarantine stations, while the remainder were shipped to South America. In course of six months, from July to the end of 1920, the disease spread throughout Belgium. Drastic steps were taken then. "279 animals had died of disease, 490 were affected; 1,859 suspected animals were killed in 85 districts comprising 222 farms" (*Hutyra*). Belgium was freed from Rinderpest in six months in 1920.

In India it has existed from the earliest times and it is, therefore, that Indian cattle generally have acquired a degree of immunity. But not so the hill cattle of India which are very susceptible, and mortality amongst them mounts from 80 to 100 per cent.

The hereditary resistance acquired by the Indian cattle is not absolute; there are always some

susceptible animals which keep up the infection. It often happens in India that the disease dies out in a province or a district or a village for several years after an epidemic. The epidemic at the time is supposed to have killed all susceptible animals, leaving only the resistant ones behind. As years pass on, the progeny of the susceptibles increase till another wave of disease comes and sweeps away again a large number of cattle. These periodical outbreaks have been surging over India. One province is affected in one year, while some other is affected in another year by severe epidemics and in the meanwhile some are dying in small numbers, or undetected cases are occurring all the time. Undetected, because of the feebleness of virulence in the animals, which pass off unobserved.

Some breeds show high mortality. The imported cattle are highly susceptible to disease, and when these are infected the mortality reaches 100 per cent. Of Indian breeds the case of high susceptibility and mortality amongst hill cattle has been mentioned. The Sindhi breed is also very susceptible and shows high mortality. The disease may affect other ruminants, such as buffalo, sheep and goat. Buffaloes are highly susceptible. In the plains the sheep rarely succumb to it. Wild animals are also liable to be caught in an epidemic. In Africa, wild ruminants were once almost extirpated in an wave of epidemic. Horse, dogs, rabbits, birds and men are immune.

Infection : The disease is caused by an ultra-visible virus which is so minute as to pass through a Berkfeld porcelain filter. Very exaggerated ideas were once

prevalent about the infective efficiency of the virus. But now many of those ideas about contact agencies for the spread of the disease have been disproved. The disease is spread by close contact during the height of infection. In the period of incubation from the first to the fourth day, attempts to communicate the disease at the Mukteswar Laboratory failed. In a regulated experiment in contacts it was found that contact, with infected animals that were infected by inoculation from the 5th to the 10th day of their inoculation, was effective. After the 10th day of infection to the 15th day, contacts failed to be infected.—(Cooper. Mukteswar: *Indian Journal of Veterinary Science and Animal Husbandry, 1932*).

The virus is very fragile and short-lived outside the body. Usually in dry weather it does not live outside 24 hours. Beaton observed in Nigeria that hides of cattle dying from Rinderpest were rendered non-infective by drying in the shade for 24 hours. When the air was moist and the temperature was low, as during rainy days, the virus lived in the shade for 36 hours but died in 48 hours. 2 hours exposure to direct sun light at 34°C. kills the virus. In the open, on pastures, the virus does not live more than 36 hours. In stalls it remains virulent not more than 20 hours. At Mukteswar infected animals separated by a wooden partition from the susceptible animals failed to infect them. Half per cent carbolic acid does not kill the virus, but 2 per cent does. Perchloride of mercury 1 : 1,000 or 1 per cent milk of lime are effective in destroying the virus. Opinions

differ as regards the exact period of the potency of the virus at various temperatures in the shade and in water. But the old ideas that it may be carried by attendants, in carts, wagons, boats and through flies etc. are changing on observing the character of the virus. Affected animals, when they are kept on a ground surrounded by a ditch and a mound, from which they cannot escape, fail to infect animals on the other side of the trench or mound, showing that infection cannot travel through the air.

The virus is easily destroyed by drying and putrefaction. Special care has to be taken to keep the virus active in the laboratory under the special laboratory control of temperature and method of keeping. If blood from an infected animal is allowed to dry, it fails to infect after 48 hours.

The question arises as to how exactly the infection occurs and spreads. Investigations are being carried on about these matters.

It has been found on observation (*Datta and Rajgopalan :* Mukteswar) that an infected animal may act as a carrier. A bull was inoculated with virus which showed reaction and survived. 74 days after the artificial infection and after it had been removed (15 days after inoculation) to a site free from infection by contact, it was found ill of rinderpest and then died. The post-mortem exmination revealed that death was due to rinderpest. This proved that animals can retain within themselves the live virus for long periods and thus carry infection unsuspectingly to new surroundings. The case of the Indian cattle

taken to Antwerp and South America in 1920, where they developed rinderpest, also confirms, according to the investigators, the Mukteswar finding. This may serve to explain the sudden appearance of the disease in a locality which cannot be traced to outside importation of cattle at the time. It is generally found that the virus does not live in the body of the affected animal for more than 15 days. The exceptions may account for causation of disease in apparently clean areas.

It was suggested that certain flies might act as vectors. Mukteswar experiments proved that if a large number of *Tabanus Orientis* flies after biting an affected animal are made to complete their meal on a susceptible animal, that animal develops rinderpest. But latter experiments (*Mukteswar*) have brought out that those laboratory conditions do not occur in nature, and so far as the *Tabanus Orientis* fly is concerned, the spread of the infection by it is most unlikely.

Use of the common path-ways may communicate the disease. There was an outbreak of rinderpest amongst the cattle in the Hissar Government Farm. About 6,000 animals are kept here. They live by themselves in a very large area of about 60 square miles. How could rinderpest come into this clean area ? It was suggested that there were paths in this area which the neighbouring villagers used. The infection must have gained entrance that way.

All these go to prove that infection may originate from carrier animals and that it spreads by contact.

Infection can be induced by the injection of the minutest quantity of blood from an infected animal. It can be conveyed by feeding with virulent blood, saliva, nasal secretion, urine, fæces, lachrymal secretion, vaginal discharge, sweat etc.

Symptoms : The incubation period is 3 to 8 days. Symptoms become evident generally from the third to the fourth day of infection. The infected animal shows rise of temperature. This is one of the earliest symptoms. It precedes other symptoms by one or two days. The temperature rises to 104 to 108 degrees F. It rises to its height on the third or the fourth day of the disease after the incubation period. It persists and goes down before death. In some cases it rapidly falls below normal at the onset of severe diarrhœa. In favourable cases it may fall gradually to normal. The height of the temperature does not necessarily correspond with the severity of other symptoms. Rise of temperature of the animals in a herd in an affected area, or in animals coming from an infected centre, will point to infection. Infection is also indicated when several animals at the same time show rise of temperature even in a clean area.

From the second or third day of fever, appear stupor and severe depression. The animal stands with the head drooping down, ears drooping and its back arched. It stands apart from other animals in the yard or in the pasture. When it is made to move with the herd it lags behind and moves sluggishly. Some may show temporary excitement for a few hours, which is replaced by stupor. The horn and

ears feel hot. The muzzle becomes dry. The skin of the limbs on their flexor side shows sweat. The hair is staring and shaggy, particularly over the vertebral column.

There is no appetite, but thirst sometimes increases. Rumination becomes retarded and then ceases. Constipation prevails. Defecation takes place at long intervals. The dung is dry, dark coloured and does not form curled cakes and is occasionally covered with mucus. Urine becomes scanty and dark coloured. There may be spasmodic switching of the muscles of the shoulders, back and quarters. With the rise of temperature, respiration and pulse are accelerated. There is cough present commonly in the beginning stage. The telltale changes in the mucous membrane become manifest from the second day and make the clinical picture characteristic. The conjuctivæ become red. The eyelids get swollen and tears flow. Later on, the secretions become thick and mucoid or mucopurulent. Transparent discharges come out of the nose, which become mucoid and purulent afterwards. The nasal mucous membrane becomes red and later on gets covered with mucopurulent deposit. The dry and fissured muzzle shows formation of brown crusts.

The important point of diagnosis is the cavity of the mouth. The mucous membrane becomes affected. There is increased flow of saliva mixed with air bubbles and often with blood. The saliva is not viscid and, therefore, does not hang in strings. The mucous membrane on the inner surface of the cheek

and on the palate becomes spotted or diffusely reddened. These spots coalesce and show like greyish yellow coating. Cakes on these separate out easily, exposing red, granular, slightly bleeding tissues. The gums also show redness, and cakes of exudates form and peel off exposing red tissues. The tongue becomes furred.

As the disease advances the discharges from the eyes, the nose and the mouth become profuse and viscid. The breath becomes foul. In cows there is similar discharge from the vagina, and the organ becomes reddened. Coats form and fall off, exposing dark bleeding surface. Changes in the female genital come early and may enable early diagnosis. The yellowish crusts over the mucous membrane which scale off, leaving raw surface on the nose, muzzle, vagina and anus, are very characteristic.

Urine is passed frequently or continually in drops. In some cases there is a characteristic affection of the skin. On the second or third day of the disease lenticular hæmorrhages appear in the udder and the scrotum. During the later stages of diarrhœa, papules of the size of pea develop in the inner surface of the thigh, on the face, sometimes on the neck, along the back and behind the shoulders. The pustules form crusts. For this reason the disease is named after pox in some provinces in India and is called *gooti* or *mata* etc.

From the third day, with the advance of the disease, constipation gives place to diarrhœa. Purging sets in. The fæces become watery, mixed with pellets

covered with blood and mucus. Later on, a fluid only comes out with flakes of mucus and blood. The colour is yellowish brown and the odour is very offensive. The abdomen becomes tender. The prostration becomes great. There is difficulty in swallowing. The animal is in extreme pain. It shakes its head from side to side so long as it can remain standing. Then it lies down and dies in great agony.

When nearing the end, the sunken dull eyes, the purulent secretion from the eyes, nose and mouth, and vagina, the foaming saliva, the grinding of the teeth, the frequent involuntary liquid fæcal evacuations, their foul odour and the fœtid odour emitted from the whole body, gives a picture of rinderpest which can hardly be mistaken for any other disease.

In cases where there had been partial hereditary immunity, the disease does not run a very severe course. Mild symptoms of rise in temperature, gastric and intestinal disturbance and catarrh and lesions on buccal membranes occur. The temperature gradually subsides and the animal becomes normal. In some cases the disease may not attract any attention at all. Sometimes there may not be any rise of temperature even in one of these milder attacks. But cattle having these mild attacks infect others all the same.

The disease lasts for 4 to 8 days. In some cases the course may extend to 2 or 3 weeks. In large farms rinderpest does not spread very rapidly. There are some cases at first, and then others follow in 6 or 7 days, and then the speed increases with greater and greater rapidity, claiming larger numbers.

It should be borne in mind that all the symptoms may not appear in any one case or any one attack. Some of the symptoms, however, will be invariably present.

Differential Diagnosis

Some diseases may be mistaken for rinderpest :

(*1*) *Malignant catarrhal fever of cattle* : This fever, with which rinderpest is often confused, resembles, in severe cases, the changes in the mucous membrane of rinderpest. Here the stupor is marked from the very beginning, while in rinderpest it comes on the second day. The difference, however, is that though the mucous membranes of the mouth, nose and eyes are severely affected, the alimentary canal and the genitals are slightly affected. The disease is not contagious ; only one or two cases may occur. The trouble in the eyes is much more serious than in rinderpest. The horn is affected and it sometimes falls off.

(*2*) *Thrush of the mouth* : There is no fever and no marked abdominal symptoms.

(*3*) *Foot-and-mouth disease* : The eruptions on the mouth are of a vesicular character and the hoof clefts are also affected similarly. There is no such abdominal disorder as in rinderpest. Foot-and-mouth disease spreads much more rapidly than rinderpest.

(*4*) *Hæmorrhagic septicæmia* : This disease is distinguished by extensive hæmorrhages and in the swelling in the throat and in the absence of mouth

lesions. Pasteurella can be found in the blood on examination. Death is very rapid in this disease.

(5) *Red dysentery*: In this case digestive disturbances appear first and then follows the febrile condition. The affection is limited to the stomach and intestines. The mucous membranes of the face remain unaffected.

(6) *Anthrax*: This disease brings about death very quickly. There are no mouth symptoms. The bacillus is found in blood. On post-mortem the spleen is found very enlarged.

(7) *Poisoning*: Poisoning may show many points in common, but in poisoning colic and abdominal pain is marked, and death is usually not so protracted.

Treatment

There is hardly any treatment of this disease. In early cases large doses of serum can save life. But it is possible to have such large doses of serum in the case of Government farms only. Serum is expensive, and where large doses are needed it may not either be available or the cost may be prohibitive. Early use of serum will save life. Serum will do no good once the symptoms are fairly developed. In the case of an epidemic in the Government farm at Hissar, some cows were treated with serum at the early stage of attack, and they were saved.

The real thing in case of an outbreak is to attempt to prevent its spread and protect the unaffected animals. Protection, therefore, is the only mass treatment possible.

In an outbreak of rinderpest the following steps should be taken :

(1) Separation of the infected cattle from the healthy cattle in three categories :

(a) Those affected.

(b) Those in contact and suspected.

(c) The healthy and unaffected and unsuspected cattle.

They all should be kept separately. The (a) and (b) groups should be separately put in 'stand still' trenched ground from which they may not come in contact with the outside cattle. Single fencing is not enough, because cattle from outside may contact those inside, with the fence in between. Where trench and a mound cannot be put up, a double fence with some yards of blank space in between may serve. A mound, however, is best.

All unaffected animals of the locality should be protected by inoculation as described hereafter.

Even when removing animals for isolation, avoid using the public road to save other people's cattle from catching contagion. Once the symptoms have developed, nature takes its own course. During the course of the disease every attempt should be made by the attendants to make the animals as comfortable as possible by arranging for their litter, and for their drinking water, by changing sides when they lie down and are unable to lift themselves, and by feeding those that may be recovering.

As only 25 to 50 per cent of the infected animals die in these attacks, it is necessary to provide

comforts to all, taking the chance of saving as many lives as possible. If the attack is in the winter season, adequate covering should be provided. When the cattle of a village are put together in isolation or 'stand still' camps, an attendant service should be organised from the householders and others concerned to see that the cattle obtain all the necessary attention in the isolation camps. Regarding the character of isolation the experience at Mukteswar should be a guide.

> "Very recently Cooper (1932) at this Institute has shown that the introduction of a healthy bull into a stall just vacated by an animal dead of acute rinderpest and only separated from other infected animals by mere board partitions may not result in infection (period of observation was 15 days). Again, the experience at Mukteswar, where susceptible and infected animals have been maintained since the very inception of the Institute about 40 years ago, only a few hundred feet apart on either side of a ridge, is that there has never been any instance of the disease spreading over to the other side. No steps whatever are taken to prevent the movement of men and traffic except for the infected cattle themselves."—(*Datta and Rajgopalan* : Mukteswar).

The 'incontacts' and suspicious cases should be similarly isolated in another location, not necessarily far away from the infected isolation camp. They should be similarly watched and cases, developing infection, should be brought to the isolation camp.

The animals in the 'suspicious' camp should be primarily protected with the 'serum alone' method, and afterwards finally protected by virus inoculation in the usual way. Thoroughly disinfect the shed and standings where cases of infection had occurred and remove healthy cattle from them for a few days to allow the virus to die out by disinfective measures. After the village cattle had all been protected, and after about 15 days had passed in camps, these may be broken up.

Rinderpest virus decomposes readily in the dead body, and the hides get free of virus in 36 hours of exposure to the air. It is advisable to save the hides and disinfect them by drying in the sun. The waste matter of the carcasses should be disposed of in the usual way.

Protective Inoculation

There are several methods in use for protecting cattle from rinderpest infection. Some of these have been developed by the research work of investigators in India. This is as it should be. India is one of the largest sufferers from this scourge. In Europe and America they have stamped out the disease by killing all affected cattle and by taking adequate preventive measures. The disease does not belong to their soil. When it finds access to their countries by any contacts, the State machineries are immediately moved to stamp out the disease. The affected animals and the suspects are killed, the State compensates for the loss in most cases.

It is different in India. It is endemic here. The disease lingers on at one place or another. In some provinces, for example in Bengal, every year there are cases from so many districts. Then again, mortality is much less in India, the cattle having acquired hereditary immunity to an extent.

The problem here is to protect. Even if it were possible to stamp out the disease, experts think that the procedure might not be a wise one. Because, if the land is made free from the disease for a number of years, the hereditary immunity may degenerate and then an epidemic coming from say, Burma, Indo-China or Tibet may do very much more mischief, and the advantage of the years of freedom from disease may be more than offset by a single calamitous outbreak and by its subsequent continuity. This is mentioned, not because it is the settled policy of the Government to do so, but whenever the question crops up of creating a buffer area in the eastern zone from which infection often travels, the above argument also comes up for consideration.

The diseases has a peculiar importance in India, claiming as it does half the mortality of cattle from all infective diseases combined together.

Investigators have been on the look-out for finding something by way of preventive, which will be cheap, sure and capable of widespread applicaton with the help of the very meagre staff that the country possesses. This is the ideal. The investigators have been working upon materials provided by their predecessors in the field in this and in other countries.

Research work has been rewarded with unexpected success in the course of the last ten years. The position today is much brighter than it was ten years ago, thanks to the research workers in the field.

The common knowledge about protection in the case of rinderpest was based upon the same facts out of which was evolved the small pox vaccination. Rinderpest, like small pox, gives immunity for life, if there is recovery from an attack. Naturally the problem was that if, by artificial means, like that of vaccination, a mild attack could be induced, then the subject would be free from further attacks.

The live virus from infected animals offered a material for use as vaccine. If the blood from an affected animal is injected subcutaneously in a susceptible animal, the disease takes hold. But the difficulty was about virulence. It happened that a large number, out of the vaccinated animals, developed severe rinderpest and died. Besides, the introduction of vaccination worked like inviting infection, because the vaccinated animals from their exudates and fæces became the foci of contamination for spreading the disease. These were some of the drawbacks for vaccinating with a blood virus. Yet the proccess with all its defects afforded protection.

The next step in advance was to take the help of immune sera. Animals were given minute doses of rinderpest vaccine, and a very mild form of disease was generated. Such animals could tolerate larger doses of virus. This was repeated till the animal could tolerate many times the fatal dose. Serum from such

animals gave passive immunity for some days, as has been explained before. Now, anti-rinderpest serum began to be used not only for giving passive immunity but also for toning down the reaction of vaccine. Thus was introduced the serum simultaneous method in rinderpest protection in place of the serum alone or vaccine alone.

Still, all was not satisfactory. Advantage was taken of the fact already known that rinderpest virus gets attenuated by passage through other animals, for example, goats. This was tried in India. Goat's blood virus came to be introduced into India as a step in advance of the use of bull blood virus. The reaction with goat blood virus was much less than with ox blood virus.

Blood virus may contain piroplasms from animals which were carriers of the piroplasms without themselves suffering from piroplasmosis. Virus from ox, so contaminated with piroplasms, occasionally gave rise to piroplasmosis in the subject of bull blood virus injection which ended fatally.

Dr. Edwards, then Director of the Imperial Institute of Veterinary Research, Mukteswar, introduced the use of goat blood virus. The advantages of goat blood virus over bull blood virus are :

(1) The virus is clean of cattle piroplasms to which goats are not susceptible.

(2) The virus had a fixed virulence which was lower than that of bull virus and was, therefore, safer. By passing through goat the virus became attenuated.

(3) The virus can be more readily and more economically manufactured in the field, from seed virus obtained from the laboratory. The operator also can satisfy himself that he has been using a potent virus.

Goat blood virus gave place to the use of bull blood virus in the field. At this stage, all over India, the following two methods for protection against rinderpest were introduced for active protection :

(1) Goat blood virus alone.

(2) Goat blood virus plus serum or serum simultaneous.

(3) 'Serum alone.'

For passive protection the 'serum alone method', of course, remained, and remains.

At this stage the discovery that not only blood but other organs of an infected animal can be used as a virus-carrying vaccine, was taken advantage of. It was found that the rinderpest virus had a peculiar attraction for the spleen and that it inhabited the spleen in large numbers. It was found experimentally that the goat spleen virus could do as well as the goat blood virus in inoculating susceptible animals.

Mr. P. J. Kerr of Bengal was the first to introduce the use of goat blood virus alone for active protection. He wanted to use blood virus alone in face of an epidemic. But before putting the method into practice he went to Mukteswar to discuss the various aspects of the matter with Mr. Ware, the Director of the Institute, and Mr. Haddow, the Serologist. He

learnt there that Mr. Haddow was going shortly to issue goat tissue virus instead of goat blood virus. So, he decided to use goat tissue vaccine, the newer product.

When Mr. Kerr was using goat blood virus alone he found the following difficulties :

(1) The technique of the method was beyond the ability of the ordinary Veterinary Assistant, because the goat has to be infected and blood drawn at the height of infection in field stations.

(2) There was unavoidadle delay of 3-4 days after arriving at the seat of infection, because the goat had to be infected and time allowed to pass till the disease appeared to be at its highest.

For these reasons when Kerr heard of the new method of using goat tissue in place of goat blood, he went in for experimenting with it for its injection alone, like goat blood virus alone. The advantages in favour of the goat tissue vaccine are :

(1) It is easy to prepare goat tissue vaccine at the head quarters and to keep it in cold storage in ampoules. Blood required immediate preparation for use.

(2) These ampoules could be sent by post.

(3) The vaccine was ready for injection on arrival.

(4) One goat gave 2,000 to 2,500 doses of vaccine as compared with only 500 doses of blood virus.

(5) It retains its potency in cold storage at 45°F. for 30 days, and the ampoules taken out of the laboratory can be used with potency for 7 days at ordinary winter temperature.

Kerr became eminently successful in the introduction of the tissue vaccine alone for rinderpest protection. He found later on that instead of sending the tissue vaccine ampoules by post they should be sent in ice by passenger train, because high temperature killed the virus.

Method : A goat is inoculated with virus using 5 c.c. emulsion. The goat reaches its height of temperature—103 to 104°F.—in 3 to 4 days. It is killed. Its abdomen is shaved and disinfected on the outside and then opened and the spleen taken out. The spleen is cut into about 1 gram (15 grains) bits. These are put into ampoules and sealed and kept at 45°F. temperature in the laboratory at head quarters for use during the next fortnight.

The one gram ampoules are sent to the field on receipt of requisition. There, the ampoules are broken and the 1 gram of tissue is put in a glass mortar and rubbed into emulsion with 0·5 per cent solution of common salt. 100 c.c. of saline solution is mixed with the tissue. The 100 c.c. of saline is put little by little in the mortar and extracted and the emulsion decanted into an enamel mug with a lid. The whole 100 c.c. is thus transferred to the mug, which is kept in the shade and in a cool place.

1 c.c. of this emulsion is used for one animal. For buffaloes which are more sensitive than cattle, only ½ c. c. is used. The emulsion is to be used on the same day. Any remaining over is spoiled and cannot be used the next day.

The experiment was repeated in 1935 on one lakh animals in Bengal. The mortality was 0·5 per cent, on account of vaccination. The immunity rendered was solid, for, animals vaccinated with 1 c.c. of goat tissue vaccine, if subjected to larger doses of tissue vaccine or blood virus after some time, did not show any reaction.

From that time onwards G.T.V. or goat tissue virus alone is being used in Bengal for protection against rinderpest. The serum is used only when severe reaction appears or for passive protection of suspected animals or for animals in the early stage of attack.

The goat tissue vaccine is being largely used now in India. There are provinces, however, like Madras, where goat tissue vaccine has not been introduced but where goat blood virus with 'serum simultaneous' is used.

It has been the policy of the Central body, the I. C. A. R., to let each province use the virus and combination of its choice. So that now in India all the five methods are in use :

(1) 'Serum alone' for passive protection.

(2) 'Serum simultaneous' with goat blood virus.

(3) Goat blood virus alone.

(4) Goat tissue vaccine alone.

(5) 'Serum simultaneous' with goat tissue vaccine.

The Provincial Veterinary Departments are left to choose whatever form or combination they find most suitable for combating rinderpest.

Bengal seems to be satisfied with a 0·5 per cent mortality due to inoculation. When measured by

lakhs, 0·5 per cent comes to a considerable figure. For example, in 1940-'41 in Bengal there were in all about 4,92,000 goat tissue vaccine inoculations ; of the inoculated animals 2,630 died or nearly 0·6 per cent or 6 per thousand died for the inoculation.

In Madras 4,19,000 animals were inoculated with 'serum simultaneus' with goat blood virus. Out of this only 131 animals died. The difference is striking. If the 4,19,000 animals of Madras were treated as in Bengal with goat tissue vaccine alone the mortality in the vaccinated would have been 2,240 as against the actual of 131, or Madras would have lost, 2,109 lives unnecessarily. The total rinderpest mortality of Madras was 16,000, and to allow 2,000 animals to die for vaccinating only 4 lakh animals would be bad.

The total bovine population, including cattle and buffaloes in Bengal and Madras and also the total inoculations against rinderpest and deaths after inoculalion, are as under. The last column gives the total mortality from rinderpest after inoculation.

(1940 census)

	Bovine population.	No. of total inoculation.	No. of death of the inoculated.
Madras—1940-'41	1,80,29,559	4,34,794	166
Bengal—1940-'41	2,27,56,281	4,92,712	2,630

Madras had inoculated a much higher proportion of its total susceptible animals and yet kept the mortality amongst the inoculated to 166, against 2,630 deaths of Bengal. Madras peasants would

naturally welcome this vaccination the more than the peasants of Bengal. The death of one cattle for every 200 presented for protection is a high figure if the loss is to be borne by the peasant, as it has to be done. In the case of Madras it is negligible. There only one animal die out of 3,000 presented for protection. Naturally, having arranged for serum simultaneous with the blood virus method of protection and having secured the highly satisfactory figure of one dead amongst 3,000 presented for protection. Madras is unwilling to accept goat tissue virus alone as the means of protection.

It is a pity that Madras did not experiment with goat tissue vaccine and the serum simultaneous method. Madras did some inoculation with goat tissue vaccine alone and the result was like that of Bengal, giving 0·5 per cent deaths. And Madras fought shy of it for fear of losing the confidence of the peasants. Bengal, it is expected, would have shown equally good results as Madras if it had adopted the 'serum simultaneous' method with the goat tissue vaccine. The cost of serum stands in the way. Instead of buying anti-rinderpest serum from Mukteswar, Bengal like Madras could make arrangement for its own anti-serums and thereby cheapen considerably the cost of serum, and use 'serum simultaneous' like Madras. The cost of serum should be put against the economic loss of the 2,000 cattle that die for vaccinating only, two and a half per cent of the total bovines.

The details of the methods about rinderpest protection have been mentioned for an intelligent

understanding of the methods pursued. It would not be possible for any private person to adopt his method of choice. Persons desiring to protect their cattle against rinderpest or any infectious disease will have to go to the Provincial Veterinary Department, and the methods chosen for the moment by the Department for the area will prevail. In Bengal serum simultaneous vaccination can be done by paying for the cost of serum which works out nearly at one rupee per animal.

Buffaloes are more susceptible and less resistant to rinderpest.

A matter of importance regarding the method of vaccinatian is the durability of immunity. Madras with its goat blood virus has found out by test carried on upto 5½ years that the protection was solid. No such definite experimental figure is available about goat tissue vaccine alone. The goat blood virus gave reaction in 75 per cent cases against 50 per cent cases with goat tissue vaccine experiment at Madras. Madras is doubtful because of this result about the durability of the immunity in case of the goat tissue vaccine. Bengal should be able to pronounce a definite opinion. There is only a vague reference in the 1940-'41 Report of the Veterinary Department, Bengal, as under, on rinderpest vaccination.

> ..... "Generally speaking, the results of vaccination in the western areas of the province are very satisfactory, whilst the immunity conferred amongst the bovines in East Bengal was not so durable and strong. This problem is really very

interesting and necessitates systematised experimentation and research."—(P. 11).

We have not, as yet, heard the last word about protection against rinderpest. Research workers are carrying on investigations, and more progress is likely to be achieved.

In the field of production of anti-serum for rinderpest, experiments are going on to make it possible to prepare a dry serum. Haddow, Sen and Roy (*Mukteswar*) have prepared a concentrated serum by precipitation of the active constituents of it. Anti-serum rinderpest, containing 0·5 per cent carbolic acid and kept in the dark retains its activity for 4 years (*Hutyra*). Blood virus lasts only a few hours at ordinary temperature and goat tissue virus is recommended to be kept for a fortnight only after preparation and storage at 45°F.

1385. HÆMORRHAGIC SEPTICÆMIA : MALIGNANT SORE THROAT

Synonyms :— *Buffalo disease, Pasteurellosis in cattle and buffalo.* **Hindi**—*Galghotu* ; **Beng.**—*Gala-phula, Kandi* ; **Guj.**—*Galghotu* ; **Kan.**—*Gantalbyani* ; **Malayalam**—*Thondaveekham* ; **Marathi**—*Galsuja* ; **Oriya**—*Tantikata, Sohana* ; **Punjabi**—*Galghotu* ; **Sindhi**—*Ghetar, Ghootko* ; **Tamil**—*Thondiadappan* ; **Telegu**—*Gontuka vapu.*

It occurs in nearly all countries, but in the regions of the temperate zone it is of minor importance. In the tropics, in Egypt, in Indo-China, the Malay Peninsula, the Philippine Islands, Java etc. it occurs in severe form.

The causal micro-organism is pasteurella. Two varieties are separated for cattle and buffalo and are called **Pasteurella Boviseptica** for cattle and **Pasteurella Bubaliseptica** for buffaloes. These two organisms correspond in all essential particulars, and in India the disease of both the cattle and the buffalo is regarded as one.

It is of great importance in India, because, next to rinderpest, hæmorrhagic septicæmia takes the largest toll, being about one-fourth of the total mortality from infectious diseases or half the mortality from rinderpest.

It principally affects buffaloes and is less common in the cattle. Still the mortality amongst cattle is not negligible. In Bengal where the buffalo population is nominal, the mortality from H. Septicæmia

amongst cattle and buffaloes is over 2,000 against 23 thousand from rinderpest out of a total cattle and buffalo mortality from infectious diseases of 31,000. Because of the nominal presence of the buffalo population, the Bengal mortality from Hæmorrhagic Septicæmia has come to be about 6 per cent only. The figures illustrate the greater susceptibility of buffaloes more clearly when the case of Madras is compared.

Mortality from Hæmorrhagic Septicæmia

Madras (1941-'42)

		1940 census population millions.		1941-42. Mortality from Hæmorrhagic Septicæmia.
Cattle	...	15·9	...	2,807
Buffalo	...	6·1	...	2,441

Nearly 16 millions of cattle contributed to about 2,800 deaths; while only 6 million buffaloes contributed to 2,400 mortality for hæmorrhagic septicæmia, showing that the incidence of mortality amongst buffaloes is nearly 2½ times more. In the Punjab where there are 9·2 million cattle and 4·9 million buffaloes, the proportion of mortality from hæmorrhagic septicæmia would be still more exaggerated in case of buffaloes.

The disease is most common amongst young animals, although older animals are not immune. Both bovine and ovine animals are susceptible. Dogs, fowls and men are immune.

The disease was considered to be one arising from moist soil. It is found that it is very much in

evidence in low lying lands subject to innundation and appears to be endemic in irrigated areas, occurring throughout the year. In the Punjab, in the riverain and canal areas, it causes a heavy annual loss amongst the cattle and buffaloes. The outbreaks occur during and after the monsoon. When there is a shower during winter the disease is almost certain to appear in the affected districts.

From laboratory experiments it appears that the pasteurella concerned has a very feeble power of resistance outside the animal body. It is easily destroyed by ordinary disinfectants. Once introduced into animal body it multiplies with great rapidity and produces toxins of a very virulent nature.

Infection : The exact mode of infection has not been found out yet, and because of our not knowing the circumstances under which infection occurs, its prevention has also become a matter of difficulty. It has been proved, however, that the disease cannot be communicated by ingestion of cultures of bacteria. But ingestion of materials from infected animals causes infection. A bull died of pneumonia 54 hours after the ingestion of 1 gramme of fæces from a calf affected with acute hæmorrhagic septicæmia. —(*Bollinger—from Hutyra*).

Gaiger and Davis (*Veterinary Pathology & Bacteriology*, 1941) mentioned :

> ......"The method of infection is by ingestion, and that the period of incubation is a few hours. The disease cannot be conveyed by mere contact or cohabitation."......

"Experimental feeding of bovines with culture and rough herbage only infects a small proportion of those fed. The remainder become highly immune to a subsequent lethal test-dose subcutaneously. Minute doses of culture, subcutaneously or intravenously, infect cattle with deadly certainty."...... —(P. 194).

As inoculation rapidly produces disease—this is supposed to be the real method of infection. Infection may result from wounds in the mucous membrane of the mouth coming in contact with the micro-organisms with food-stuff or in grazing and during ingestion. The bite of insects may be the more direct way of infection. After rains, biting flies are hatched out in large numbers, and the prevalence of the disease at that season makes the supposition more plausible that it is due to insect bites. It has not been possible to know much about the mode of infection. The disease seems to appear spontaneously, and cause mortality and then disappear equally spontaneously.

Symptoms: Hæmorrhagic Septicæmia brings death very quickly, and in that respect it resembles anthrax. The symptoms appear suddenly and is followed by death. Often the animal is found dead and thus gives the first indication of the disease before any symptom of disease could draw attention to it. Those animals that live for sometime show the following symptoms :

Temperature rises very high—107°F. to 110°F. There is great depression, and painful, hard, hot swellings appear in the dewlap, throat and between

the lower mixillæ. The swellings are large and do not get depressed on pressure. The swelling may extend to the cheeks and the parotid region backwards to the breast as far as the shoulder. There is dripping of saliva, not like that of rinderpest, which is thin and foamy, but thick, sticky saliva falling in strings. There is thick mucous discharge from the nose. The mucous membrane of the mouth shows a hæmorrhagic deep red colour. This is the special feature of the disease. On opening the mouth, the tongue may show normal appearance, but on each side of the floor of the mouth there is swelling and redness. In some cases the tongue becomes swollen and protrudes out of the mouth.

The pulse becomes frequent and respiration is difficult verging on suffocation. The nostrils dilate and the movement of the thorax is exggerated in an effort to breathe. Colic appears along with dysentery and diarrhœa and other intestinal symptoms. There is a discharge of dirty red fluid and mucus.

The animal turns to look at its flank or abdomen; this is a sign of colic. It can hardly move, and lies down in exhaustion. Pregnant animals abort. The animal groans in pain, grinds its teeth or bellows. Death takes place from suffocation or convulsions. Death occurs in 6 to 24 hours from the appearance of the symptoms. In another form of the disease, dysentery and diarrhœa may not be accompanied by the swelling of the throat. The disease may attack the chest. It then takes a longer course and death takes place from pneumonia.

Differential Diagnosis

(*1*) *Anthrax* : In suddenness of death it is like anthrax as also in the rise of temperature. In anthrax also there is abdominal pain, and swelling over parts of the body. But the swellings of anthrax are not hot and painful as is the case with hæmorrhagic septicæmia. From outward symptoms it may be difficult to differentiate Hæmorrhagic Septicæmia from Anthrax in some cases. Only microscopic examination of blood can reveal the character of the two different organisms. On post-mortem, anthrax is easily identified by the black colour of the blood and by the very enlarged spleen, the pulp being dark and friable. These two post-mortem indications are absent in hæmorrhagic septicæmia.

(*2*) *Black Quarter* : It is easier to distinguish from black quarter in which there is the absence of the swelling of the throat. The swellings of black quarter are hot and painful at first but cold and painless afterwards. Crackling of gas bubbles are often felt on the swellings of black quarter, although in all cases of black quarter, this gas crackling symptom may not develop. Black quarter is more a disease of the calves of 3 to 6 months of age. Hæmorrhagic Septicæmia is more prevalent amongst buffaloes.

(*3*) *Rinderpest* : It is distinguished from rinderpest by the history of its beginning. Death is not sudden in rindepest. The œdematous swellings of the throat etc. are absent in rinderpest.

Control of the disease: The disease disappears as mysteriously as it appeares, working havoc in about 10 days at any locality after which the outbreak is over. Mortality is from 80 to 100 per cent of those attacked. Isolation is to be taken up on the lines already indicated. The place of keeping the animals should be changed. Those in contact should be kept separately from those out of contact. If the disease appears in the separated batches, they should again be separated and taken to now sites. The changing of site is very important as the soil is blamed for harbouring the offending organisms. The stalls and the floor and walls may act as centres of infection, so that the old sheds should be vacated for about a month.

Immunisation: Protection is given by serum. 'Serum simultaneous' is also in use as a preventive measure. Where there are definite areas and seasons of attack, 'serum simultaneous' inoculation should be done before the commencement of the season.

As the outbreak is of short duration, serum alone also does a great deal of good in checking an outbreak. With regard to this disease, preventive measures have not been able to bring down the mortality substantially as in the case of rinderpest. Treatment by medicines is of no use once the disease has taken hold of an animal. The serum acts as a curative.

It has been mentioned that with the introduction of bacteriophage this disease almost disappeared from Indo-China. But work in this direction does not seem to have been done in India.

1386. BLACK QUARTER

Synonyms :—*Blackleg, Emphysematous Gangrene.* **Hindi**—*Ektraqia Goli, Sujwa Garhi, Zahrbad* ; **Assamese**—*Gathia* ; **Bengali**—*Badla, Sannipat* ; **Guj.**—*Gathio-tav* ; **Kan.**—*Chepparoga, Chappibavu* ; **Malayalam**—*Karinkal* ; **Mara.**—*Ghatya, Farya* ; **Oriya**—*Chatna* ; **Punjabi**—*Goli* ; **Sindhi**—*Tookli, Kanarho Dhadhri* ; **Tamil**—*Chappai Noyi* ; **Telegu**—*Jebbavapu.*

It is an acute, febrile, endemic, infective disease of the cattle and sheep characterised by the formation of crepitant swellings over various parts of the body. It does not spread from animal to animal. Infection is due to **clostridium chauvæi** which gain entrance by ingestion in cattle and generally through wounds in sheep.

Occurrence : The diseaae occurs in all countries, in mountain regions also, in valleys with marshy, boggy soil or low lying damp meadows. It is less common in stall-fed animals than in pasture animals. In India it is the low lying or marshy soils that show most incidence. Stall-infection may appear at any time, but pasture-infection takes place in the warmer months of summer. The season of infection varies also with districts. The disease is similar to gas-gangrene of man, and the bacillus of Black Quarter belongs to the same group that causes gas-gangrene. The opinion at present held is that infection in cases of black quarter in India is generally due to several kinds of allied bacilli and not alone to clostridium

chauvæi. Cl. Welchii or the gas-gangrene bacillus is often found accompanying infections with Cl. Chauvæi and so also is found Cl. Œdemotis maligni, the bacillus for malignant œdema. These mixed bacilli give rise to conditions which may resemble black quarter so closely that no clinical difference is possible (*Shirlow*).

Susceptibility : The most susceptible age is between 6 months and 2 years. The disease may occur in younger calves and also in older animals.

It is a typical instance of a disease from soil infection, and susceptible animals are infected by the ingestion of spores contained in soil dust etc. with food and water or by the infection of wounds with such materials. The infection through wounds is more general in the case of sheep than in the case of cattle.

Although it is held that infection occurs through ingestion, it has been found that experimentally one cannot infect by feeding cultures, and the precise way of how the infection occurs is yet undetermined. Man is immune to black quarter.

The bacilli are anaerobic and form very resistant spores which keep their infectivity for a very long time under most unfavourable conditions. The bacilli can enter the soil from infected materials and from carcasses, and cause the disease to persist in some localities and pastures, as has been explained in the case of anthrax spores. Black Quarter stands third in the mortality list from infectious diseases, coming after Rinderpest and Hæmorrhagic Septicæmia. The

total mortality from Black Quarter in British India in 1937-'38 was 19,474 forming 8·2 per cent of the total of deaths due to contagious diseases.

Symptoms: Usually the first thing noticed is lameness. It may be of one fore-leg or one hind-leg. The animal becomes dull and stands apart and refuses food. Respiration becomes difficult and the temperature rises. The local swelling which is one of the most marked characteristics may appear on the upper part of the fore-leg or hind-leg. It also appears near the chest, on the shoulders, on the neck or on the abdominal wall and also occasionally in the maxillary muscles, the muscles of the tongue, the larynx and pharynx. In many cases the swellings are limited to individual groups of muscles. The swellings increase in size rapidly, become hot and painful at first and later become cold and painless. The swelling, on pressure, is found to be emphysematous and there is crackling on manipulation. The crackling sound and feel is a definite symptom. As the hand is passed over with some pressure there is a feeling that it is moving on rolling mustard seeds—the gases moving and rolling give that impression, the gases that are locked in the fissures of the muscles. In some cases this particular crackling feel may be absent, the gas lying deeper in the muscle. If the swelling is cut, it is found to be engorged with dark red, bloody exudate. The exudate from the swellings have a rancid odour as of stale *ghee*. The surface of the swellings gives exudates which also give the rancid odour. Hairs occasionally

come off from the swelled parts on pulling. In rare cases of running an acute course, the swellings may be absent. The lymphatic glands are swollen and often show hæmorrhage. The period of incubation is usually from 1 to 3 days, seldom more than 5 days.

With the progress of the disease, the animal becomes unable to stand, and lies down, and sometimes tympanitis appears. Severe difficulty of respiration is felt and the animal dies in convulsive attempts to breathe and in great agony. The course runs from 12 hours to 2 days. But in some cases it lingers for 4 to 10 days.

In case of death from black quarter, the blood is found to be clotted in the heart, if it is opened after sometime. The carcass does not easily putrefy. The muscles in swellings develop a rancid odour.

Protection : There may be certain localities or fields which are known to be infective, while others in the vicinity may be clean. Care should be taken to avoid infected localities by the cattle of susceptible age. Such fields improve on ploughing up and by the addition of lime. Wherever this is possible, it should be done.

Protection is obtained by vaccine and serum inoculation. This subject is engaging the serious attention of the Imperial Council of Agricultural Research, and advantage is being taken of the newer experiments in the Mukteswar Laboratory. In the earlier days protection was used to be given by vaccination through spore culture which consisted of the use of dry muscle powder or dried and heated

muscle of an infected calf. The protection was effective but uncertain in virulence. Some showed severe reaction and death followed, while in other cases there was no immunity developed, probably on account of the spores having died due to excessive heat treatment. A standardised vaccine could not be obtained.

Later on, it was discovered that toxins are formed when the bacilli were multiplying and anti-toxins also were formed locally. This phenomenon was taken advantage of by locally infecting a muscle and expressing its juice out, which gave the anti-toxin or aggressins. This was introduced into India but was abandoned in favour of a better method.

The next step of advance was to use cultures killed by formalin. The dead culture did not react severely and the anti-toxins gave the desired immunity.

Still later, it was found that cultures lost their pathogenic or disease-creating property if developed on some chemical substances instead of on organic bodies. These cultures though they lost their pathogenicity, retained their immunising values. This finding was corroborated at Mukteswar.

At present Mukteswar supplies both anti-serum and vaccine for black quarter. Both are safe and efficient.

The anti-serum gives protection for nine or ten days, sufficient to ward off an outbreak. After the outbreak is over the herd is protected by vaccine. The immunity lasts 6 months to one year, sufficient

for the calves to pass over the most susceptible period of their lives.

As regards steps to be taken during an outbreak, and disinfection and disposal, it has to be emphasised that the same precautions are to be taken as have been indicated in the case of anthrax (1387). The spores of clostridium chauvæi are very resistant, and no half measures should be taken about isolation, disinfection and burial of the dead.

1387. ANTHRAX

Synonyms :— *Splenic fever, Splenic apoplexy, Malignant pustule, Malignant carbuncle, Woolsorters disease (in men).* **Hindi**—*Garhi, Goli, Gilti*; **Beng.**—*Tarka, Paschima*; **Guj.**—*Bhamariya, Klio-tav*; **Kanar.**—*Gantlukattu*; **Malay.**—*Adappan*; **Mar.**—*Goli, Fanshi, Sushya*; **Oriya**—*Chora, Pilhi*; **Punj.**—*Sat*, **Sindhi**—*Karo Wa*; **Tamil**—*Adappan*; **Telegu**—*Domma.*

Anthrax is a rapidly fatal disease of blood caused by **bacillus anthracis** which destroys blood and prevents it from functioning. Anthrax is a disease of the soil, found in agricultural regions. It is indigenous to certain localities; marshy and periodically flooded soil favouring its growth. It is endemic in these areas. The summer months are generally found to be more favourable for infections to occur. The disease is known from antiquity in Asia and also in Europe. It has a home in Africa as it has in Asia, India, Burma, Indo-China etc.

All animals may contract the disease. The young are the most susceptible. The cattle and sheep and goat are the most frequently affected. Other animals affected in order of frequency are the camel, the horse, the pig, dog, fox, cat, rabbit and guinea pig. Rats and mice also may be affected. Birds possess a considerable amount of immunity. Frogs are immune. Men contract the disease by inoculation, the bacilli gaining entrance through cuts and wounds or through ingestion of meat containing spores and insufficiently cooked, and also by inhalation as in the case of wool-sorters and brush factory workers.

Herbivorous animals in a wild state are highly susceptible. The anthrax bacilli are one of the largest sized pathogenic bacteria and can easily be detected under the microscope. The bacillus is a spore-producing organism. It is an aerobic organism and requires the presence of oxygen to be kept alive, but when in difficulty it creates, in the presence of oxygen, spores out of itself, and in that condition can live in a quiescent state for years with or without contact with oxygen. The spores can be budded into bacillus form when provided with proper temperature and environments. After assuming bacterial form, it can again sporulate and remain for an indefinite time in that condition. It is, therefore, that when a spot in a field or pasture becomes infected by, say, a carcass of an animal dead of anthrax, the exudates containing the bacilli go into spore form and remain in the earth. When the rainy season comes proper moisture and temperature make the spores break into bacilli form and multiply. The grass on the plot becomes infected, and animals ingesting that grass get infection. In the dry season the living bacilli form spores and remain in that condition so that an infected spot continues to spread infection from year to year.

The bacilli being aerobic cannot live in a dead body because of the absence of oxygen and cannot form spores there also for the same reason. Therefore, when the body of an animal, dead of anthrax, is not opened and is buried under earth, the source of infection dies. But if some blood is spilled anywhere, as it dries, the bacilli form spores and live on in that

form. Therefore dry blood will continue to be a source of infection; if at any future time suitable environments be present it will become active. Under earth there are other bacilli, and the putrefactive organisms from the body itself are there which may kill the spores also. But dry blood or excreta, containing spores, remain as sources of infection.

The spores can live in water and under water mixed with earth or dirt. When any animal drinks such water, containing the spore, they get infected. When an animal, dead of anthrax, is thrown into a water course, its spores go on living in water and thereby continue to contaminate the water. Grasses growing on the sides of water courses very often serve to introduce anthrax infection in a locality for this reason. A case has been reported by Naik of the detection of the source of anthrax infection to a stagnant pool in a *nullah*. (*Indian Journal of Veterinary Science & Animal Husbandry*; September, 1938; P. 243). Affected animals during the rainy season used to cross the *nullah*. They left spores during the rains, which began infecting animals during the dry season. During the dry season the animals were being stall-fed with dry grass, and, therefore, apparently at that season of the year there should have been no risk of anthrax infection. They were infected because they had been led to drink the water in the stagnant pools left in the *nullah*. The scum and mud of the suspicious pool on injection into the animal body developed anthrax; the presence of another bacilli was tested microscopically.

If spread in a thin layer the bacilli are killed by drying in sunlight for 6½ to 15 hours ; in thick layer and in the dark it lives for 2 or 3 weeks. In dried blood they can live for a month or longer, and then form spores on addition of water. In the gastric juice the bacilli die in 15 minutes. Liquid manure kills the bacilli and not the spores in 2 to 3 hours. The spores remain virulent. Salvarsan in a dilution of 1 : 50,000 inhibits the growth of the bacilli.

Spores are not killed by simple drying. When dried on silk they can remain germinative for 32 years. Spores die in manure at a temperature of 72 to 76°C. in 4 days. The drying and salting of hides does not destroy the spores adhering to them. In lime baths they remain living for 125 days. In tanning baths of lime, the spores may be killed according to some in 12 to 17 days ; but others find that in water for tan pits and tannery discharge the spores remain living. It is a very difficult task to free tannery discharges from anthrax spores by killing them. In tanneries the hides of animals, dead of anthrax, bring the spores in and tannery lime tanks and tannery discharge water are found to contain spores all the time.

Disinfectants : The bacilli are killed easily by the usual disinfectants. But the spores are resistant to normal dilutions in which the disinfectants are used. Corrosive sublimate 1 : 1,000 kills the spores in 20 minutes and the action is increased by the addition of ½ per cent Hydrochloric acid or 2 per cent Carbolic acid. Iodine or chlorine water 2 per cent,

Formaldehyde 2 per cent, Permanganate 5 per cent, Carbolic acid 5 per cent, Chloride of lime 5 per cent are effective in killing spores. Caustic lye one per cent kills them. The resistance of spores varies according to the strains. Hides can be disinfected free of spores by soaking in a 3 per cent salt solution at 24°C. for 24 hours, and then in a pickle of 2 per cent hydrochloric acid and 10 per cent salt solution at 28°C. for 48 hours. The hides are not injured thereby. Hair can be disinfected by soaking in 1 per cent solution of formalin for 4 to 6 hours, and wool by first soaking and then keeping it in 2 to 2·5 per cent formalin. They can be disinfected in steam under a nominal pressure of 2¼ lbs.

Natural infection in herbivorous animals occurs from the ingestion of spores contained in the food. In grazing, some dust is sure to be consumed and this also applies to dry fodder. Surface soil and water may be contaminated even by dust carried by wind from infected materials. Spores buried under earth may come up with the rising level of water. Earth containing spores may be dug up by earth worms and brought to the surface. The fæces of infected animals play also a part in spreading infection. Infected cows may possibly transmit infection through milk.

In contrast to infection through food, infection through skin in animals is seldom seen. Anthrax frequently occurs during foot-and-mouth disease. This may be due to reduced vitality and, therefore, greater susceptibility. Anthrax is not usually transmitted directly from animal to animal.

It was generally believed that by ingestion of spores and bacilli, the bacilli get killed by the gastric juice, while spores pass unaffected to the intestines where they merge out as bacilli and multiply. Koch's inoculation experiments confirmed this view. In opposition to this theory is Besredka's theory that the cutaneous system constitutes the only part of the body capable of receiving infection, and if subcutaneous or interperitonial infection is usually positive it is because of the fact that the skin is also injured at the same time. This skin infection theory has not found much favour, although upon Besredka's theory a new method of protective inoculation has developed.

Symptoms : Infection develops in peracute, acute, subacute and in external types according to the susceptibility of the animal, its age and to the strain of the bacilli. As with most infective diseases, the first cases are immensely fatal. During the end of the outbreak mild cases only occur and most of them recover.

The outbreak generally begins in peracute form. One or several animals in the best of conditions are found dead. Very often this is the first indication of the outbreak. There may be blood or amber-coloured discharge at the nostrils, eversion of rectum, exposing dark mucous membrane. The carcass gets distended soon and very greatly. These signs suggest anthrax. But microscopic examination can only reveal the cause of death for certainty. If the animal is not long dead, if it is within 8 or 10 hours, the ear may be pricked with a needle and a drop of blood taken on a slide and

covered up in smear with another slide. This has to be sent for examination for diagnosis. But the owner is to proceed on the supposition that the case was one of anthrax and take all necessary precautions.

If a peracute case of attack which is called also fulminant or apoplectic-anthrax, is discovered in a living condition, there will be found difficulty of respiration, cynosis, plaintive cries, convulsions. Blood is seen to come out at the nostrils and death occurs in a few minutes or a few hours.

Next are the acute and subacute forms. These types are known as Anthrax fever, Splenic fever or Internal anthrax. In the acute form death occurs in 24 hours. In the subacute form the animal may linger on for several days and die or recover. The temperature rises from 104 to 107°F. or even higher. Discharge from nostrils comes out, sometimes mixed with blood. There is blood in the fæces and also in the urine. The pulse becomes small. There is great difficulty of breathing. Colic and tympanitis are present. Cattle generally show these symptoms and also horses. In some cases, pharyngitis and swelling of the neck occurs. Milk secretion soon ceases. When some is secreted it is yellowish or blood-stained. Pregnant animals often abort. The mortality is from 70 to 90 per cent.

The third type is the 'External Anthrax'. It is a less severe form of the disease. A good percentage recovers. Horses in India are generally affected by this type. There are diffuse swellings under the skin, at the head, throat, neck, breast, shoulder and

the other parts. The swellings occur suddenly and spread rapidly. They are hot and painful at first and become cold and doughy afterwards. This is differentiated from the swellings of black quarter by the absence of the gas crackling sound on pressure of the fingers.

Post-mortem examination of suspected cases of anthrax should be undertaken with great care, as the opening of the body means exposing the bacilli to the air, and aiding them to form spores. When a carcass has to be examined it should be at the site of the place of burial.

Prevalence : Nearly 5 per cent of the total deaths of animals through contagious diseases, is due to anthrax. Total mortality in British India from anthrax was as under :

Year.		Mortality.
1934-35	...	5,869
1935-36	...	7,118
1936-37	...	10,478
1937-38	...	10,396

The reported cases about anthrax used to be smaller than the actual on account of some cases of anthrax being entered as other diseases in the absence of proper diagnosis or post-mortem. Although more protective measures are being taken, the death rate seems to have doubled between 1935 and 1938. But the fact, perhaps, is that more deaths are now being classed as anthrax than before with the progress of the vigilance of the Veterinary Department. It may

also be assumed that protective inoculation has not yet minimised the mortality. The reported cases for 1934-'35 were all fatal, showing 100 per cent mortality. Attacks and deaths in provinces from anthrax for 1934-'35 were as under :

Province.	Total seizures.	Total deaths.	Remarks.
Assam	839	839	
Bengal	1167	1167	
	1	1	Equine.
Bihar and Orissa	246	246	
	3	3	,,
U. P.	275	275	
Punjab	3	3	
N. W. F. P.	12	12	
Madras	2,300	2,300	
C. P. & Berar	1,670	1,670	
	6,513	6,513	

—(*Figures quoted from the paper by M. I. Malik ; Proc. 2nd Meeting of the A. H. Wing*, 1936 ; P. 111).

Immunisation and protection : Pasteur's vaccine is used in Europe for immunisation. In India anti-serum is being used which, however, is of doubtful utility, because the immunity conferred is very transient.

In 1936, in the second Meeting of the Animal Husbandry Wing, this subject was drawn pointed attention to by Mr. Malik. The preparation of a vaccine at Mukteswar was urged, as was done in other countries and in Burma, in place of anti-serum only.

Mr. Mitchell informed the Meeting that he had brought a strain of vaccine from South Africa, and was manufacturing vaccine in Burma with very satisfactory results. The meeting was informed that vaccines were being tried at Mukteswar and that the difficulty lay in their getting a suitable strain and that the tendency of strains was to vary in virulence.

In the 1940-'41 Report of Mukteswar it is found that anthrax spore vaccine was manufactured for issue in that year for the first time.

South Africa has, however, gone on very far with the immunisation against anthrax by spore vaccine. In 1939, Max Sterne of Onderstepoort showed in a paper that they had been using an avirulent variant strain of anthrax spores with great success. Type $34F_2$ was such that the vaccine could be stored for a year without loss of efficiency. After the middle of 1938 the vaccines were being issued in a suspension of 0·5 per cent of saponin in 50 per cent glycerine saline. This improved the immunising power of the vaccine, and there were no complaints from the owners of herds regarding excessive reaction.

Thousands of cattle used to die annually from anthrax in Transkei. There, the disease, like rinderpest in India, was very prevalent. But the protection given by spore vaccine showed wonderful results. In 1938, May-June period, the number of animals vaccinated with avirulent spore vaccine was 15,59,530. Out of these only 30 animals died of anthrax in the following season, where several thousands would have died normally. The avirulent

vaccines were made from uncapsulated variants. Anthrax bacilli generally have a capsule. Here the uncapsulated ones were used for culture. It is not mentioned in the Mukteswar report whether Mukteswar is also using the avirulent strain, which has been so successful in Africa. The process described by Max Sterne was an improvement on the saponin-containing vaccines which were used everywhere in replacement of Pasteur's original two operation vaccine immunisation.

In case of outbreak: The infected animals are advised to be isolated as described below, and the unaffected ones should be treated with anti-serum and vaccine inoculation. There is, however, a practical difficulty in this. The veterinary departments can be induced to take up serum inoculation only after the presence of anthrax bacilli in the dead (or living) animal has been proved. As the carcass putrefies in a very short time, smears that might give results in microscopic examination cannot by obtained usually by the veterinarian when he calls to see a carcass. At the next attack, if the veterinarian is available, he may take a blood smear and send it to the head quarters for examination. After the examination shows anthrax bacilli, the machinery for inoculation by serum is moved. By the time the anti-serum reaches the locality, the attack may be at its tail end, when there would be no further use of the anti-serum for that locality. These difficulties are real but not unsurmountable and should be surmounted if the cattle are to be protected against

anthrax. For the moment we have to leave immunisation out of the picture except in those provinces or localities where the Veterinary Department carries on inoculation in anticipation of attack in areas liable to be infected seasonally. The other steps to be taken during an outbreak are as under :

(1) Evacuation of infected stables.
(2) Disposal of the dead and dying.
(3) Change in pasture or fodder supply.
(4) Disinfection.
(4) Treatment.

1. **Evacuation of infected stables** : When there is a case of death from anthrax, or when there is a suspected case of sudden death, the proper course would be to vacate the place. The animals that were in close contact with the infected animal should be separated from those out of contact. Both the batches should be taken to a dry high ground, for camping. The change of site minimises very greatly the chance of new infection. The temperature of the separated animals should be taken morning and evening daily. Those showing rise of temperature should be isolated. After every new case, the ground should be changed.

2. **Disposal of the dead and dying** : The dying should be allowed to die, taking care to see that infection is not spread and that exudates and excreta are burnt. The body should be buried very deep (6 ft.) under ground. Where possible, a layer of lime should be placed first then the carcass should be

dropped down and the sides and top of the body should receive a layer of lime also. Then earth should be replaced. Earth soiled by the animal should be scraped up and buried. The animal should not be dragged along roads but must be carried. The body should not be opened except for examination, and only at the place of burial.

If a post-mortem is done smears from spleen and heart should be taken. Animals dying of anthrax show black blood and black muscles. There is great elongation and enlargement of the spleen which becomes fragile. From these two signs, blackness of blood and muscle and the greatly enlarged spleen, a diagnosis can be made subject to confirmation by microscopic examination. In anthrax, blood does not coagulate. If coagulated blood is found in any organ, it will not be a case of anthrax.

After burial, burn the surface and surroundings, and put a fence over the burial ground. The instruments for post-mortem should be thoroughly boiled.

3. **Change in pasture and fodder supply**: The source of infection may be anything. Until this is definitely known, it is the best plan to change both pasture and the supply of fodder to new ones, suspecting that the infection may have come from infected pasture or infected dry roughage.

4. **Disinfection**: Use of fire and of bleaching powder has also been suggested. All the paraphernalia pertaining to the infected animal and stable should be thoroughly disinfected in boiling alkali, or in any of the usual disinfectants. Whatever is possible to

be destroyed without much loss should be destroyed for safety.

5. **Treatment :** The suffering animals should be kept free from flies, so that these may not spread the infection. For this purpose, a fire may be kept smouldering with wet straw and cow dung at several points. The smoke may irritate the eyes, but flies will be kept away.

The inoculation period of anthrax infection varies with the species and their susceptibility. For cattle and horses it is 3 days, for sheep 2 to 4 days. Rabbits and guinea pigs on artificial inoculation develop disease in 24 to 48 hours.

Thermometer should be used to watch for any beginning of attacks, and a knowledge of the incubation period will be helpful in keeping such a watch.

For treatment, anti-serum should be depended upon. Where this is not available, antiseptics should be given in the form of carbolic lotion drenching.

Carbolic Acid—1 dram.
Common Salt—½ ounce.

Mix in thick gruel, and then drench. 5 per cent carbolic lotion should be applied externally on the swellings. Other antiseptics, such as M. B. 693, may be given. Salvarsan and neosalvarsan in ten times human doses may be given to the cattle.

When the animal can drink, give gruel and water, later green feeds. Use *neem* leaves and *neem* leaf decoction freely as antiseptic.

Anthrax in man : Man may be infected through the skin. Malignant pustule and malignant carbuncles

form. The disease is generally found in those who are occupied or come in contact with dead animals—veterinarians, herd-attendants, butchers, men engaged in the preparation of hides, hair bristles and wool. The infection may be conveyed to man by flies also.

The development of pustules or anthrax carbuncle begins with stabbing pains at the site of infection, generally on the face, neck or arms. These are soon followed by red nodules which develop into blackish red bulla, filled with red fluid. These rupture and the tissue gets necrosed, and fresh nodules and fresh bulla form in the neighbourhood. The temperature rises. General septicæmic symptoms appear and the patient dies.

Anti-serum is very useful in such cases. Intravenous injection of drugs like salvarsan and neosalvarsan are being tried also.

1388. FOOT-AND-MOUTH DISEASE

Synonyms :—*Epizootic aphtha, Aphthous fever.* **Hindi**—*Munhkhur, Munh-pau-ki bimari, Khurpaka, Rora, Khora* ; **Assam.**—*Chabka* ; **Bengali**—*Khura, Aisho* ; **Guj.**—*Movasa, Mova, Kharva* ; **Kana.**—*Kalu Boi Jwara* : **Mar.**—*Lal, Khoor-kut* ; **Oriya**—*Phatooa, Asua* ; **Punjabi** — *Munkhur* ; **Sindhi** — *Samaro, Chharee* ; **Tamil**—*Komari* ; **Telegu**—*Gallu, Kaligallu.*

Nature of the disease : It is a highly infectious, rapidly spreading, acute, contagious, benign disease, specially of the ruminants characterised by vesicular eruptions in the mouth, on the feet and on the udder. Cattle, buffaloes, goats and sheep are affected. Pig, and horses may contract the disease. Men are very rarely affected. This disease is constantly prevalent in India.

The causal virus : The disease is caused by a virus which appears to be the minutest of all the viruses. The virus is ultra-microscopic and it cannot be cultivated in any media outside the animal body. On infection a few vesicles on the mucous membrane of the mouth appear which pass unobserved. There is no outward indication. When these vesicles are mature and break, then the virus passes on to the blood stream and creates symptoms which are observable by the rise of temperature and by the redness of the muzzle, and later by vesicles and salivation. This virus surpasses all others in its

capacity to be carried about and to spread infection. The vesicles contain a fluid which is full of virus. Indeed, so powerful are they that a dilution of the vesicular fluid to the strength of one in five millions is capable of carrying infection. The infection spreads by mere contact and, of course, through food and drink and through animate medium as men, dogs, vermin, birds who may carry them through contact with the infected animal. By merely treading upon the saliva, the infection may be carried with the feet or under the shoes for any distance. Black's Dictionary, illustrates by an imaginary example as to how it can spread. Mr. A. is a cattle drover in whose herd food-and-mouth disease has appeared. He comes to a market and quite innocently shakes hand with Mr. B. Mr. B. contacts Messrs. C. D. E. F. These persons go to their homes and attend to their cattle, and the cattle of C. D. E. F. get infected. This imaginary example is really typical of the extremely propagating character of the contagion. With such an ubiquitous infecting virus, it is impossible to prevent the spread of the disease in a herd, when a single animal gets infected.

After one attack an animal remains usually immune for one year. It is also seen that an animal may get infected a second time soon after recovery. This is due to the fact that there are three different strains—A. B. and C. of the virus. Recovery from the attack of one extends immunity to that type only, but the animal remains susceptible to the attack from the other strains or types of the virus.

Character of the virus: The virus in the epithelial tissues is very resistant to drying. It remains infectious in the dry state on the hairs of cattle for 4 weeks, on hay for 15 days, and on bran for 20 weeks. But the virus of the vesicular lymph after drying is killed at the room temperature in 24 hours. The epithelial virus is also very resistant to putrefaction. In washings it remains infectious for 103 days and in cess-pools till 39 days. In contact with urine it soon loses efficiency, being attacked by the ammonia evolved. Manure becomes non-infectious in 2 to 4 days.

Amongst the antiseptics, caustic soda or potash acts very well and destroys the virus in 1 to 3 per cent solution. Ordinary washing soda in 4 per cent solution needs heating with the virus to 50 to 60°C. for destruction. One per cent formalin acts similarly to caustic soda solution. For use as the disinfectant a hot washing soda solution may be causticised by the addition of some lime to it and allowed to settle. This solution may be used for disinfection of the clothes of attendants by boiling these in it.

Prevalence: In England and in Europe foot-and-mouth disease has been taken up very seriously by the Government. In England the drive is for stamping out the disease by slaughter of the affected animals. Thousands of pound-sterlings are spent for this work. The rule is to compensate the owner for any cattle destroyed by the Government. In spite of such measures England is never free at a stretch for more than a few years, when the disease reappears.

The reason is that although affected cattle may be stopped entry and infectious cases slaughtered, yet the virus may find entry through imported hay. One such attack was traced to such import of hay in Great Britain.

In India also it has been found that fodder from the affected area or even carts spread the disease.

It is a benign disease, and the death rate is small. Emaciated and weak animals die of the after-effects of the disease, from debility or from development of other troubles. In Europe there is a malignant form with a very high mortality, but this is not found in India. Even in Europe there are not many cases of the malignant type. In the malignant form the disease is fatal as the result of direct action of the virus on the heart muscle.

Infection : Ingestion of contaminated food and water readily conveys the infection. This is the principal source of infection.

Infection is carried through the use of infected straw, mangers, floors of the stall, pasture grounds, foot paths, railway wagons, and also by the affected animals through road and rail transport. Cattle markets, dealers, attendants and others play an important part in carrying the infection. Transmission of disease to distant places may occur through the transportation of infected materials like straw, *bhoosa*, oil cake etc., because dried epithelium in *bhoosa* bran etc. may live for months.

Through all these and other channels infection is contracted with extreme ease. Mere contact with an

infected animal is sufficient to cause infection. The saliva may contain the virus 9 hours after infection, even before the primary vesicles have appeared in the mouth. The most infective period is during the formation of the vesicles and when they are breaking, when the contents of the vesicles become mixed with the broken epithelium. Later on, the infectivity of the saliva diminishes. 10 days after the onset of the symptoms, the saliva becomes non-infectious. Usually it is non-infectious from the fifth or sixth day after infection, i.e., fourth or fifth day after the appearance of the symptoms.

Sir Albert Howard's bullocks brushed their noses with animals suffering from foot-and-mouth disease from the other side of the fence and yet escaped infection. (see Vol. I, *Introductory*, P. 42). It was believed that the resistance was due to the more healthful upkeep of his animals.

It may equally be that they brushed their noses after the period of virulence, after five six days had passed off. It might have also been that the cattle on the unaffected side were immune because of a previous attack of the disease. It may be also that the new contacts were immunised with the inoculation received during contact without developing any perceptible symptom of the disease.

Symptoms : The first observable symptom after infection (the primary formation of vesicle being not observed) is a rise of temperature. The young, robust animals show marked rise, the older ones may show so slight a rise as to escape observation. The temperature

rises rapidly for one or two days and falls rapidly when the vesicles appear. During the first attack of fever, shivering may occur. The mouth, horns and the extremities become hot. There may be tenderness of feet which may exhibit itself in lameness, as one of the first symptoms. The mucous membrane on the inner surface of the lips and on the gums is hot, dry and reddened. Saliva begins to hang from the mouth. Rumination is retarded and feeding also is stopped. The animal keeps the mouth closed and only opens it occasionally with a smacking sound. On opening the mouth forcibly, a large amount of saliva escapes and the mucous membrane of the mouth shows the same changes as on the lips and gums.

On the second or third day of the disease, the vesicles appear. The vesicles are $\frac{1}{3}$rd to 1 inch in diameter. On the under surface of the tongue the vesicles may be larger. In one to three days the vesicles burst and expose a red, moist and painful erosion, surrounded by white or grey remnants of the bullae.

In one or two days, the erosions become covered with fresh epithelium and the wound gets healed. As soon as the erosions get healed, the animal begins to take food. In cows, small vesicles appear on the udders, and if not broken by the milker, these burst in 36 to 48 hours, showing the same character as the vesicles in the mouth. Vesicles may appear in the muzzle, and at the root of the horns.

Simultaneous with the affection of the mouth, the hoofs become affected. Lameness or difficulty of movement is observable. The skin of the coronary

border pad and the clefts of the hoofs are found to be hot, swollen and painful. The clefts vesicles may appear of a small size, containing at first clear and then dirty fluid. New epithelium is formed slowly under the crusts, and in one or two weeks pain and swelling of the feet subside. When ulceration is severe, the coronary border may be separated from the horny part, and may even expose the corium. Sometimes the mouth only is affected, and sometimes the feet only.

Usually all symptoms of fever disappear in three or four days. Recovery takes place in 15 to 30 days. If the animal is neglected, or worked while suffering from the disease, the hoofs may drop off, abscesses may form and even death may ensue.

Treatment : Nursing and care are very necessary. In order to protect the feet from the attacks of maggots, it is the practice in many places to keep the animals standing in a shallow pool of water. This combines isolation with protection from deposition of maggot and consequent injury to the hoofs. But this is not a commendable practice for the mud and dirt getting into the clefts continue to irritate and may cause ulceration.

Animals should be kept on hard, open ground. Some litter may be spread. The hygiene of the mouth should be attended to. Water heated with *neem* leaf and salt should be used for washing the mouth several times a day. The udder, teats and feet should have the same wash two or three times a day. The feet should be better protected with a very dilute lotion of copper

sulphate as a wash. After washing the surface may be painted with a coat of tar thinned with kerosene oil. This will keep off the flies and work as an antiseptic. The feet should be lifted one by one, and the adhering dirt should be cleaned off and the surface washed. In working bullocks, the shoeing should be taken off, otherwise the wound may continue to fester under the iron plates. If the animal is milking, care should be taken to keep the udder free from milk. Care should also be taken to milk without injury to the teats. In severe attacks the calves die and the mortality amongst young suckling calves is large. They should be objects of special care in case of an outbreak, while taking isolation or preventive measures.

Walker and Taylor of the Punjab recommended the introduction of iodine intravenously in the jugular vein.

Iodine	...	1 gram.
Potash iodide	...	2 grams.
Distilled water	...	300 c.c.

100 c.c. for adults and 25 to 50 c.c. for calves is the dose.

The injection is to be made on the detection of a rise of temperature, and before the vesicles appear. It was claimed that iodine injection cuts short the disease.

The Fourth Report of the Foot-and-Mouth Disease Research Committee in England mentioned that after a thorough trial it was found that the results found in India could not be confirmed. Later on, Ware in

India tried it in many cases. (see P. 334). Iodine injection after the Punjab formula was given, but he also has come to the conclusion that iodine has no special therapeutic effect in foot-and-mouth disease except for its general tonic value.

Diet : During the height of attack, when the vesicles are there, it is difficult for the animal to chew anything. The best thing would be to feed gruel and supply water to allay thirst. Some green, tender grass may be presented to be taken at will. With the progress of healing, green tender grass should constitute the food, with some gruel in addition before the animal can revert to its normal feed.

Complications : In the course of the disease complicatons may occur altering its benign course. Pus-forming bacteria may invade the eroded surface. The superficial erosions may be converted into deep ulcers. These may form pus and the surrounding tissues may swell. Suppuration may commence in the feet, and this is more common. With cleanliness and frequent daily antiseptic wash, suppuration should not occur ; but neglect often accounts for mischief at the feet. The inflammation is aggravated by walking, and more frequently by mud and filth which gain entrance into the eroded surfaces. With more severe inflammation abscesses may form on the corona, in between the clefts, and rarely on the pads. Sometimes the injury may extend up, and in other cases pus may enter deeper, forming a fistula and causing the hoofs to separate and fall off.

Sometimes accumulated milk in the udders of milking cows may give rise to mastitis and result in ultimate loss of the affected quarters of the udder. From wound infections bacterial septicæmia may affect the animal with fatal consequence. If the animal is obliged to lie down on account of pain or suppuration in the feet, gangrene of the side on which the animal may be lying may ensue with fatal termination.

Every year in every province many thousands of animals die of foot-and-mouth disease. The suckling calves are most generally the victims. The death rate among debilitated cattle is rather high. But no statistics are available. In fact, in India we have so many very fatal contagious diseases that foot-and-mouth disease, showing a lesser rate of mortality, is almost being tolerated. Besides, no cheap immunising agent has yet been discovered. And this stands in the way of controlling the disease or reducing its death rate.

Immunisation : Hyper-immunised serum is used in Europe to give temporary passive immunity so that the onward course of the disease may be arrested in any locality. This is not done in India. Dr. J. T. Edwards (Director, Imperial Institute of Veterinary Research, Mukteswar, 1927) in his edition of "A Hand-Book for Stock Owners" recommended the following method for cutting short the course of attack in a herd :

> "When foot-and-mouth disease breaks out in a herd, and, as is very likely to be deemed, it is almost impossible to prevent its spread, it is often considered expedient and advisable to allow it to

spread, by artificial means, quickly, so that the disturbances caused by its introduction are got over within a short time. This is effected by smearing the mouths of all animals in the herd with saliva taken from the mouths of the suffering animals. It is a sound procedure, for the saliva is usually very poor in the germ, and often the germ is absent from the saliva at the later stages (when, of course, the procedure would be useless); it is, therefore, better to take the mixed saliva of several animals for the application. The disease thus set up is much milder, as a rule, than the disease contracted naturally (often, as has been said, from an infected animal in a very early stage), and the outbreak by these means is not infrequently effectually prevented from lingering on".—(P. 37-'8)

This method of protection is known as Emergency Inoculation (aphthisation). Hutyra recommends that "in order to prevent severe losses, it is advisable to employ this method only when the infection is mild in character and no fatal cases have occurred among the adult animals".

The technique recommended is to allow the affected animals to chew pieces of lint which are then taken to the unaffected animals to chew.

If this Emergency Inoculation is adopted, the question of 'stand still' camps of isolation does not arise. I should suppose that between the two the Emergency Inoculation is to be preferred. The protection from isolation camps may be doubtful owing to the very rapid and efficient spreading

capacity that the disease possesses, eluding all ordinary attempts at isolation.

Isolation: The affected animal and those in immedite contact (on either side of the affected animal) should be isolated separately, the affected in an isolation camp and the incontacts in anothor. The incontacts should be washed with a 2 per cent solution of carbolic acid, their heads and legs receiving greater attention. In milking cows the udder should be disinfected.

The isolation camps would be 'stand still' camps as described under rinderpest. There shall be one difference as regards attendants. Whereas the attendants might not have camped with the animals in the case of rinderpest, in case of foot-and-mouth disease, in which man acts as carrier, the attendants should remain in the camps, and food and diet for men and animals should be taken to these and left just outside the fencing. The suppliers should not go inside. Isolation may be broken up a week after if no fresh cases are reported.

The milk of affected animals may be used after boiling, provided there are no vesicles on the teats, and when the milk has not altered in appearance.

In conclusion, it is necessary to emphasise our helpless position with regard to this disease. The article on the control of foot-and-mouth disease by iodine referred to by Ware and Banerji (*Indian Journal of Veterinary Science & Animal Husbandry*, 1932) begins as follows:

"Although foot-and-mouth disease in India is not looked upon with the same dread as in European

countries, owing to the comparatively *low value of the animals* commonly affected, yet when it appears amongst valuable working bullocks or in a Dairy of milch cows, as it does only too often, it causes considerable inconvenience, not to mention actual financial loss, and any efficient method of cutting short such outbreaks, whether by biological or chemotherapeutical means, would be greatly welcomed by stock-owners in this country. Incidentally it may be observed that this disease interferes considerably with the experimental work of this Institute (*Mukteswar*) where several hundred animals are constantly maintained; for it breaks out amongst the new purchases, usually in a virulent form several times a year with monotonous regularity."—(P. 103).

In course of the article, experiments with iodine on infected cattle are described and the reader comes across cases of how the disease comes in with 'monotonous regularity' in the central sanctum of our Cattle Disease Research establishment and also gets an idea of the number of deaths it causes among the affected cattle.

1. "On the 27th September, 1926, 5 or 6 out of 30 bulls accommodated in the Silinguri Kraal on the Mukteswar Estate were reported to be suffering from Foot-and-Mouth Disease. ... on the following day 22 of them were found to be showing well-defined lesions of the disease." ... —(P. 108). All recovered after, in average, 20 days.

2. "An outbreak was also reported from Bhulmaria Kraal on 30th September, 1926, and on examination the following day 20 bulls out of 29 were found to have developed conspicuous lesions of Foot-and-Mouth Disease." ... —(P. 112).

..."9 out of 20 animals, all of which were already in a poor and debilitated condition, eventually succumbed to the disease." ... —(P. 116).

3. Work was begun after this in April, 1930. The article says: ...... "In April of that year, 83 hill bulls were purchased and accommodated in Sitla Kraal attached to this Institute and on 26th of that month, 19 of the animals were found to have developed mouth lesions of the disease." ......—(P. 116). The average duration of lesions was 30·3 to 23·5 days in two batches.

4. Twenty six animals were purchased and 3 of them showed lesions of foot-and-mouth disease. The whole lot was treated for preventive use of iodine, and only 11 were kept in control. Only 6 animals did not contract the disease in spite of iodine protection.

If this has been happening under the control of the Mukteswar Institute, the reader may imagine what havoc is done amongst the general cattle population of India and how many debilitated cattle are dying annually. The opening remarks refer to the 'low value of the animals.' But these low-valued animals practically constitute the only movable property of the agriculturists. So, the loss is gigantic.

That more attention has not been paid in India is certainly not due to the 'low value of the animals'

for, that will apply to the case of rinderpest infection also, but because our research workers are overwhelmed with the work on the more fatal diseases and also because up to now no possible way of prevention of the disease has been found suitable for Indian conditions.

..."Outbreaks of the (foot-and-mouth) disease amongst cattle are very common throughout India, even more so than cattle plague; it shows a much greater tendency to spread than this disease, and the germ of the disease, which is also an ultra-visible virus, is more resistant, and more frequently spread by indirect means—by persons, fodder litter, and other articles that have been in contact with the sick animals; and also, it seems, through the air.

"Whereas in Europe, and particularly in England, great expenditure is entailed in controlling foot-and-mouth disease, in India it is regarded as not worthy of such close attention, its relatively lower significance is attributable to two reasons mainly :—(i) there prevail in India contagious diseases which cause much greater mortality, notably cattle plague and hæmorrhagic septicæmia, and which, therefore, demand first attention, and, (ii) the mortality from the disease among Indian cattle is very low and would scarcely warrant the application of wide-spread measures of control such as would be very difficult to apply in any case in Indian conditions."

..."the disease varies considerably in severity in different outbreaks, and the cattle of some districts,

especially of the hills, appear to be more susceptible than those of others. Young calves sometimes succumb to the disease in an acute form; again, old animals seem to be more susceptible than strong young adult animals.

"The losses caused by the disease are not, however, to be measured by the mortality. While the animals are affected, they suffer from much loss of condition, mainly from inability to consume their usual food, from diminution or cessation of milk yield in the case of milch cattle or from inability to work through lameness in the case of working cattle. When the available food supply is coarse and scanty, a large number of deaths may thus occur in affected herds, especially among the weaker animals, not so much through the direct effects of the disease as from the inability of the animals to consume enough food for their sustenance."
—(Edward : *A Hand-Book for Stock Owners*, P. 34-'5).

The above gives a true picture of the position with regard to foot-and-mouth disease in India. It was written in 1927. Eighteen years have since then rolled by. Veterinary science has made very notable progress, but we are where we were in 1927 in this matter, and have advanced not a single step in India. It is a helpless condition and we can only wish for more attention to be given to it and more luck to the research workers in India and abroad. Iodine injection promised something, but it has proved to be illusive. After that many other chemotherapic agents, dyes and bacteriocides have been tried and recommended

from different sources, but none has yet stood the general tests.

Mercury preparations and iron preparations had been claimed to do good but were found wanting. Various preparations of arsenic were tried with ardour without any practical results Tartar emetic, potassium iodide, and quinine, failed to influence the disease. Extensive experiments with various aniline dyes, their arsenical preparations, urea derivatives, preparations containing iodine, sulphur, formol and tar produced equally negative results.

Yeast preparations with albumin were tried by special commissions and the claims made for them could not be substantiated.

In the field of vaccine and serum, experiments and claims have been equally disappointing. The virus refuses to be cultivated in artificial media, and thus has produced nearly a stalemate. Immune sera continue to be made, but they can give immunity in large doses only and for a period not sufficient to cover an outbreak, so that occasionally two or three anti-sera inoculations have to be made at great cost.

In view of all this, we have patiently to bear with the evil of foot-and-mouth disease, as we do with many of our other ills, and concentrate our attention on better nursing, better general asceptic handling of the animals, and maintain them in better surroundings and give them better feeding to develop greater natural resistance.

1389. THREE DAY FEVER : DENGUE

Synonyms :— *Ephemeral fever, Stiff sickness.*

Hindi—*Vil, Charmekh, Oochwali.*

It is an acute fever of all kinds of cattle. It is a form of Dengue which runs its course for three days after which the animal recovers, or rarely dies. It is common in North Western India and the adjoining areas. It is prevalent in Egypt, Transvaal, Natal, Cape Colony and in the West Indies. It is seen generally during or after the rains. It is not contagious, but probably the infection is carried by insects (mosquitoes, culex, fatigans). The infecting organism is a virus of the ultra-visible class which affects the blood. The period of incubation is two to three days. It makes its appearance suddenly ; several animals may be attacked, and the attack may occur simultaneously in different localities.

Symptoms : The onset is sudden. It is exhibited by a rise of temperature to 104 to 107°F. Along with fever, muscular rigidity in one or more extremities is seen. The stiffness may extend to the neck or even to the whole body. The stiffness causes lameness. Sometimes the animal is unable to stand, and when it stands, it does so with the back arched. There is loss of appetite, rumination ceases, and there is difficulty in swallowing. There may be constipation or diarrhœa.

The symptoms of rise of temperature and lameness may make it resemble black quarter, while by temperature and diarrhœa, rinderpest may be suspected and

mistaken for it. Only a small portion of the herd, about twenty per cent, may be attacked.

The disease passes off in three days and deaths are rare. In post-mortem examination the blood is found to clot very rapidly.

Treatment : Nursing according to symptoms is all that is required. A dose of Epsom Salts ($\frac{1}{2}$ to 1 lb.) is recommended in the early stages of the attack.

Preventive measures : When there is apprehension that the disease may be black quarter or rinderpest, it would be wise to keep the affected animal isolated. No immunising agent is necessary, and there is none for it.

1390. COW-POX

Synonyms :—*Variola, Vaccina.* **Hindi**—*Mata, Cheechak.*

Pox in man and cattle : Pox is a common name for the disease in men and in cows, in sheep and goats, in camels and horses. It is an acute, febrile, contagious disease characterised by the appearance of papular vesicles on the skin and the adjoint membranes. The disease is caused by an ultra-virus.

It is believed that pox in all the animals is one in origin but has taken different characters after having passed innumerable times through those animals. The identity is established by the fact that pox viruses from different animals when passed through rabbits are converted into cow-pox. There is no doubt that there is a very close relationship between human pox and cow-pox. It is maintained that human pox when passed on to the cow becomes converted into cow-pox. It is held that the original cow-pox was communicated from man to the cow. The experience in Europe, where cow-pox has become rare with the extirpation of pox in man, corroborates this view. Other animals also are susceptible to human pox. Human pox by its passage through the cow becomes attenuated. This attenuated virus in the cow is used for vaccinating man, giving rise only to local cutaneous eruption. This local eruption in man creates anti-bodies which emerging from the locality mix with the blood stream, conferring total

immunity. In man one vaccination confers immunity for several years. The immunity in the cow is not so lasting.

The pox virus is very resistant to heat. In glycerine it would live even when heated up to 180°C., and remain virulent in glycerine if kept in the dark for 8 to 10 months. Ordinarily drying at 57·5°C. for six minutes kills it,

Incidence : In healthy cows the disease is communicated by affected cows, but more usually by men who have been freshly inoculated with the human pox virus. This is evidenced by the fact that cow-pox follows human vaccination. In a herd the disease is communicated by milkers, by conveying the content of pustules of affected animals to other cows when milking. Objects such as straw or food or dung may also spread the disease.

Symptoms : It is a mild disease in cows. After an incubation of 4 to 7 days the disease makes its appearance with a slight rise of temperature. There is reduced appetite and retarded rumination. The teats become warmer and more swollen than usual. On the teats papules appear on the second or third day. They are of the size of a lentil or pea. In 1 or 2 more days the papules show vesicles. The appearance of the vesicle varies from reddish or bluish to dull surface according to the depth of it under the skin. They mature in 8 to 11 days, and then show a central depression or umbilication. Later on, the vesicles suppurate and then dry into crusts. These fall off leaving scars.

The number of vesicles is small, from one to twenty, usually on the teats and on the udder. In the males, vesicles may appear on the scrotum. In severe cases vesicles may appear in the thigh or in the lower abdomen or on the chest, neck and muzzle.

The vesicles of foot-and-mouth disease are much larger than those of pox and can thereby be differentiated. In foot-and-mouth disease, the corona at the foot is also affected, which is not the case with cow-pox.

Treatment: The udder in cows should be kept clean and dry. The animals in milk should be milked with great care. Leaving the milk in the udders is bad and may lead to mastitis. Sucking by the calves may injure the vesicles. Careful milking has to be done. The pustules may easily harbour pyogenic bacteria and cause ulceration and other complications. When the vesicles burst, the site is to be washed twice daily with warm *neem* leaf lotion. Later on, antiseptic ointment, such as boric ointment, should be applied. Animals may be protected by inoculation with the same lymph as is used in the case of man and in the same way by scarification. But this is unnecessary. The disease in oxen does not spread rapidly. Sanitary care and caution about the milkers and attendants are all that are necessary. The same milkers should not be used for milking healthy and affected cows. Milk from affected animals may be used after boiling, if the colour is normal.

In preparing vaccine for human pox, a calf about 6 months old, is used. The skin of the abdomen is

shaved, cleansed and scarified and inoculated with a vaccine which has passed alternately through rabbits and calves. Papules and vesicles appear in the usual course. The vesicles are collected with a special squeezing spoon. This provides the pulp. The pulp is mixed with 50 per cent glycerine, alkalinised to pH 7·6 and 0·1 per cent oil of cloves added. The material is stored at —11°C. and can be kept for 2 years. Glycerine and clove oil kill contaminating bacteria, if any were present. From one calf a thousand doses of vaccine may be collected. Small pox virus passed through calves or rabbits become vaccina, and on inoculation to man prevents infection from pox for several years.

1391. CONTAGIOUS PLEURO-PNEUMONIA

It is a specific disease of the cattle and contagious in nature. The lungs and pleura are mainly affected, and there is profuse exudation of lymph into the connective tissues of lungs and into the pleural cavity. The disease is caused by a specific polymorphous organism.

It was at one time thought that this disease was non-existent in India. But recent investigations have definitely proved that the disease in a contagious form exists and is responsible for a good deal of loss of animal life. For example, Assam is one of the provinces in which the disease has been definitely proved to be present, and where at present research work is being conducted with the help of the Mukteswar Institute to devise means for combating it.

It was very prevalent in Europe. It has been brought under control by extensive slaughter of affected and suspected cattle. In England it has been stamped out at very great expense to the State by way of compensation to the owners whose affected and suspected cattle used to be destroyed. The disease has its home in Asia, where it is endemic.

The micro-organism : Previously it was believed that the organism concerned was a filtrable virus and that it could be only seen as specs from cultures. But recent researches have revealed the character of the organism. Various names have been given by various workers. Turner, Campbell and Dick named it *Borrelomyces peripneumoniæ.* It is a form of *schizomycetes* as originally demonstrated by M' Fadyean.

Susceptibility: Under natural conditions, the disease occurs in cattle and allied animals, such as buffalo, bison etc. Other animals and man are not susceptible to the infection. The susceptibility varies individually, and also according to the breed and mode of life. There are many found in a herd which are resistant to the disease. In experimental inoculation, about 20 per cent of calves do not react.

Natural infection: Infection takes place through the nasal passage by breathing air exhaled by affected animals. The mere presence of an animal in a herd is enough to spread the disease gradually. The nearest neighbours are first infected. Apparently healthy animals retaining the bacteria in the lung cavities may be infectious even for 2 or 3 years after recovery, and inoculated animals may also be infectious after the subsidence of the inoculation reaction, if changes were developed in the lungs.

Symptoms: The incubation period after subcutaneous infection is 6 to 27 days. After inhalation it ranges from 12 to 16 days. In natural infection the period is probably longer, being about 4 weeks. The symptoms develop gradually as **croupous pneumonia**. The temperature rises slightly and there is dry painful cough. This ought to rouse suspicion. The cough gradually becomes more and more frequent, specially in the morning, while standing up, while drinking or when the animal is exposed to cold. The appetite is impaired, rumination is prolonged and milk secretion is reduced. Sometimes œdematous swelling of the neck is observed. Signs of respiratory trouble

become gradually more pronounced. In some cases mucopurulent discharge appears from the nose. In percussion some dullness is felt on one or both sides behind the shoulder blade and some distance up to a certain height. On auscultation, weak vesicular breathing is observed with some crepitations. When the pleura is affected, a friction sound is heard. But in advanced cases a low moan may mask other sounds.

Urine is diminished and becomes dark-coloured. With the progress of the disease the temperature rises to 105 or 106, and remains at that till the end. In later stages the skin loses elasticity and the hair loses gloss. Constipation and diarrhœa may appear with lowered vitality.

The disease may create a general septicæmia only exhibited by fever and may stop at that stage and the patient may recover. Pleuro-pneumonia with very high fever may bring about death even in course of a week. But generally the disease lingers on, and runs a course of about 4 weeks when about 30 to 50 per cent cases end fatally. Those that show recovery may keep wounds within the lungs which at any future time may break out making the disease apparent. In mild cases the recovery may be complete.

Differential Diagnosis. It is very difficult to differentiate the disease from **pneumona pleuritis** or pulmonary tuberculosis from the above symptoms alone without either microscopic or post-mortem examination. In differential diagnosis, hæmorrhagic septicæmia, septic pneumonia should also be considered. The presence of tuberculosis by the tuberculin

test does not rule out a case of combined attack of both.

Treatment : No effective drug for the treatment of the disease has been found yet. Neosalvarson was recommended but has not proved to be effective. The Assam Provincial Veterinary Report (1940-'41) mentions that the injection of Novarsenobillon (N. A. B). through the intravenous route "appeared to be promising."

Treatment with anti-serum has not much to recommend about it. Protection by the use of sera and vaccine has not progressed sufficiently for application to Indian conditions, although protective inoculation under certain conditions has proved effective in reducing the loss of animals. But there are many practical disadvantages to the adoption of this measure, one of which is that even inoculated animals may turn to be a source of infection after sometime.

Isolation : Affected animals should be isolated. These animals may be allowed to live in hygienic conditions, and properly fed and cared for. Leaving the animals to nature to enjoy sunshine and have nourishing food may be conducive to the recovery of protracted cases. But the apparently cured animals should, whenever possible, be bacteriologically examined before they are allowed to mix with the herd.

1392. TUBERCULOSIS

Synonyms :—*Consumption, Phthisis* ; **Hind.**—*Sukha, Khanazir, Kshaya* ; **Assam.**—*Kheh Rog* ; **Guj., Mara., Kanar., Malay.**—*Kshaya.* **Punjabi**—*Hanjiran* ; **Sindhi**—*Sila* ; **Tamil**—*Kshayam* ; **Telegu**—*Kshaya.*

Tuberculosis : It is the same disease in a modified form to which men are subject. Tuberculosis of the cow frequently affects children. Lymphatics, bones and joints are affected. Bovine infection, however, takes no part in the tuberculosis of the lungs. Infection from cow to man is generally conveyed through the milk of affected cows. The tubercle bacilli cannot withstand boiling temperature. By boiling milk the bacilli present are destroyed. In India, therefore, the chance of bovine tuberculosis infecting man is rare on account of the general practice of drinking milk invariably after boiling.

Bovine tuberculosis takes an important place in Europe where very many cows are affected. The artificial conditions of life of milch cattle there, and less exposure to sun is responsible for the great prevalence of tuberculosis amongst cows and cattle generally. In India the disease is there, but comparatively very much less. Reports from slaughter-houses seem to confirm the presence of a certain number of tubercular cows. But cases of advanced tuberculosis with involvement of pleura and thoracic lymphatic glands are rarely seen.

Even in India tuberculosis is more prevalent in dairy herds kept under European conditions with a

view to obtain the maximum yield of milk. In the small herds of cultivators where the cattle have more of out-door life, the disease is comparatively rare. In spite of its rarity it is well worth knowing all about the disease, so that its spread might be checked by knowing at first which of the cattle are suffering from the disease.

Susceptibility : Most animals can contract the disease either naturally or through inoculation. The cattle are specially susceptible to it. Goat and sheep are remarkably immune. Horses, mules and asses are rarely affected, as also dogs and cats. Camels develop the disease. Apes and monkeys in confinement die from the disease. This is about the bovine as distinct from the tuberculosis of man. One form of tuberculosis affects birds called avian tuberculosis. Sometimes it occurs as epidemic amongst fowls, turkeys and ducks.

Tubercle bacilli is an obligatory parasite, but it is believed that it may live as a saprophyte. It is an acid-fast bacillus, and there are only several of this class. It grows both in the presence and absence of oxygen. Diffused day light kills cultures in 7 to 18 days. Strong light kills the bacilli in sputum in a few hours. In dried sputum it may remain infective for months, and in water for several weeks. Moist heat at 140°F. kills it in one hour. Boiling kills in half an hour. It is propagated by inhalation and also by ingestion. Drinking tuberculous milk is a frequent cause of calves inheriting the disease from their dams.

In Great Britain, it is estimated that no less than 30 per cent of all cattle are tuberculous. According to the evidence of the Economic Advisory Council, 40 per cent give positive reaction to the tuberculin test. The economic loss through bovine tuberculosis is estimated at two million pounds annually in Great Britain. As the number of cases is large, State endeavour to stamp out the disease is equally significant. In several countries, including Great Britain, legislation requires of the owner of cattle to give notice of cases of open tuberculosis, and the law provides for slaughtering under compensation all open cases with definite clinical signs of tuberculosis. In 1934 compensation payment in Great Britain amounted to £78,077, or about rupees ten lakhs, when 22,000 cattle were destroyed.

The virulence of the bacilli: In cattle the bacilli of the bovine type are highly virulent. After subcutaneous inoculation of 0·05 gram of culture, severe progressive tuberculosis develops. On the other hand, inoculation of cattle with the human type only gives rise to a localised tubercular process, and it does not become generalised. Young animals become severely affected by ingestion of materials containing the bovine bacilli. The bacillus is not often found in the sputum of affected cattle, although this is the principal infectious secretion. The fæces of the affected animal plays, however, an important part in spreading the infection. It usually happens that affected cattle swallow the expectorated secretion or sputum containing bacilli from the lungs. These do

not die in the stomach or in the intestines, but are voided with the fæces. In addition, bacilli from intestinal ulcers, or from affected liver also find their way out with the fæces. The fæces, therefore, of animals, severely affected with tuberculosis, contain living bacilli and contribute largely towards infection of the stalls and also of the soil. From the soil or from the stalls in the form of dust, these bacilli, in a living condition, enter into the animal system through inhalation.

Urine and milk also contain bacilli and form sources of infection. Animals that throw out tubercular bacilli or which form the open cases are continual sources of infection, whether they exhibit other clinical symptoms or not. Animals which react to the tuberculin test should, however, not be classed with these open cases. Tuberculin reactors may be far from being injuriously affected, and if clinical symptoms are absent, if their excreta and scretions are found to be without the bacilli, then mere reaction to the tuberculin test should place an animal on the suspicious class only. In Great Britain legal steps for destruction is taken only for those animals that are suffering from mammary tuberculosis or giving tuberculous milk or those suffering from tuberculous emaciation or with chronic cough associated with definite clinical symptoms of tuberculosis.

Tubercular changes: In cattle tubercles occur most frequently in the region of the thorax and the lungs. The neighbouring glands are specially affected. The nodules of tubercle may be found in the lung

tissue in the form of grey caseous nodules or groups of nodules. The bronchi are also involved. Of course, all the visceral organs may be affected—the alimentary canal, the liver, the pleura, the mesenteric lymph glands, the spleen, the kidneys, the nasal cavities, nasopharynx and the udders.

Symptoms: In natural infection the incubation period is long; it may be several months or years before the disease becomes manifest by clinical symptoms.

Pulmonary is the commonest form of the disease. In the earlier stage there is a short, dry, forced cough occurring when the mucous membrane of the air passage is irritated by cold or dusty air, or when the circulation is increased by running or on exercise or on drinking cold water. Exhaustion becomes apparent on exercise.

Later on, as the disease advances, lung-symptoms begin to be more pronounced. Cough becomes more frequent and painful. Sometimes it is dry. Sometimes mucopurulent expectoration comes out in the cavity of the mouth, sometimes it is discharged through the nose, more generally it is swallowed. By opening the mouth after a cough, sputum may be found in front of the soft palate between the tongue and the posterior molar teeth. When examined under the microscope this will show pus, alveolar epithelium from lungs, elastic fibres and occasionally tubercle bacilli. Respiration becomes more and more difficult with the progress of the disease.

On auscultation, vesicular breathing is sometimes heard exaggerated, sometimes attenuated, and in some

areas inaudible. In moderately advanced cases dry rustling or moist crackling sounds may be heard. When the lung injury travels more to the surface, the percussion sound may become more or less dull. When large cavities are formed, tympanic and amphoric notes are heard. The lymph glands show change and inflammation.

Tuberculosis may not be confined to the lungs, as has been said, but may attack any organ or bone or joint. Specific characteristics develop according to the organs or the bones attacked.

Anæmia develops and emaciation proceeds and gives the characteristic appearance of advanced cases of tuberculosis.

When the digestive tract is affected ulcers may develop in the mouth. In intestines tuberculosis causes digestive trouble and periodical colicky pains occur. The fæces become thin or semi-fluid, which may contain pus and streaks of blood and mucus.

When the bacilli lodge themselves in the udder, there is a thickening of the udder. Sometimes hard, painless nodes develop in glandular tissues. The teats get distorted and sometimes atrophy occurs. In the tuberculosis of the udder, milk, which was normal in the early stages of the attack, is affected and changes its character. It becomes thin and exhibits fine flakes. Later on, milk becomes yellowish and of watery consistency, showing large quantity of flakes which sink to the bottom on standing.

In bones it usually affects single ribs where it creates localised swelling. Among joints, the knee is

generally first affected. Symptoms are exhibited of painful swelling and impairment of the function of the affected joint. The neighbouring tendons become affected, thickened and painful.

Diagnosis : Tuberculosis cannot be absolutely diagnosed on clinical symptoms in the early stages. Symptoms most suggestive of disease are the gradual break-down of general health, arrest of growth in young animals, the periodic attacks of fever, affectation of lungs and of enlargement of the lymph glands. When glands simply enlarge without other symptoms, the suspicion is that the organ concerned is affected. In chronic organic tuberculosis lymph glands are not generally involved.

The surest method of diagnosis is to get the tubercle bacilli in microscopic examination of exudates or discharges or from the contents of the cavities. Serological tests are also important which takes advantage of the phenomenon of allergy.

Allergy is a term used for the supersensitiveness shown by animals, suffering from certain diseases, to an antigen made from the organism causing the disease. It is to some extent similar to the phenomenon of *anaphylaxis*. But there is an important difference. In allergy there is an intense local reaction at the site of inoculation, and there may be a rise of temperature for a few hours. But there is no other general reaction or shock. In anaphylaxis there is no local reaction and there is usually a fall of temperature accompanied by a shock.

For diagnosis of tuberculosis and paratuberculosis, allergic reaction is induced in the animal under test by the inoculation of antigen obtained from a culture of the bacilli. The antigen used for diagnosis of tuberculosis is known as tuberculin, and that used for diagnosis of paratuberculosis is known as para-tuberculin. Paratuberculin made by a particular process is called Johnin.

Tuberculin is made by filtering tubercle bacilli culture. The filtrate is free from bacilli but contains bodies which react on the tissues, if injected. In actual preparation several methods are in use. Some sterilise the culture by heat, others prepare it as raw filtrate, then sterilise it with 0·5 per cent formalin. Again, a precipitate of the filtrate with ammonium sulphate in glycerine solution is also used as tuberculin. Mukteswar has its own tuberculin which is available for use in India.

There are various methods of employing the tuberculin test. Various claims are made for the various methods.

In the subcutaneous tuberculin test a subcutaneous injection is made of the tuberculin. In reacting animals the temperature gradually rises in 8 to 16 hours and falls again in about the same time. Animals showing this wave of rise and fall of temperature are regarded as reactors.

Another is the ophthalmic tuberculin test in which a few drops of tuberculin are put in the eye. Affected animals show an inflammatory reaction. With the use of concentrated bovine tuberculin, the

test was found to be very useful for diagnostic purpose.

Eyelid test : Injection of tuberculin in the eyelid is also a method in which a swelling of the eyelid occurs, accompanied by a purulent discharge from the eyes in reactors. There is no rise of temperature.

In the cutaneous method or dermal test, tuberculin is injected in the thickness of the skin, which develops a swelling in the affected animal. Double intradermal test has been adopted by the Ministry of Agriculture in Great Britain as being the most dependable of all the method of testing. In this test a first injection of a few drops of tuberculin is made in the skin. There is a small swelling in case of non-reactors, whereas the reactors show much greater swelling. A second injection at the same point is made after 48 hours and measurements taken after 24 hours from the time of the second injection, and again at 48 hours. The technique recommended by the I.V.R.I. Mukteswar is as follows :

Concentrated tuberculin as supplied by the Mukteswar Institute is used $\frac{1}{10}$ c.c. per injection. If the non-reactors show large swelling, the tuberculin may be diluted to half or one fourth or one fifth of its original strength by water and $\frac{1}{10}$ c.c. of the diluted tuberculin is used.

1. Cleanse the area at the middle of the side of the neck after shaving it.

2. Pinch up a fold of the shaved area and hold it firmly between the thumb and the forefinger of the left hand.

3. Insert the needle obliquely in the pinched up portion. Use a short thick needle and see that the needle goes beyond the epidermis and enters the dermis. Push in the requisite quantity, a wheal or a small nodule will rise at the site of injection.

4. Inject the second test dose after an interval of 48 hours exactly at the site of the first injection. This dose must be of the same quantity as the first dose.

Some swelling is produced even in animals which are not reactors, but tuberculous animals show much greater swelling.

5. Record the measurement of thickness by reading with a calliper at the commencement of the test.

6. Measure after 24 hours after the first test and 48 hours after or at the beginning of the second test injection and again take measurement after 24 and 48 hours after the 2nd injection. In reactors the swelling will be very considerable. Besides, in the reactors the swelling shows a considerable degree of local heat and tenderness with some degree of œdematous infiltration. There is a characteristic feel, a peculiar sensation to the touch which speaks more than the increased measurement does. Buffaloes react more powerfully than cattle.

Value of test: The test is an absolute indication of the presence of the tubercle bacilli in the system. It speaks nothing about the intensity of the attack. Many animals with positive reaction to tuberculin may never develop any symptoms clinically and may die as perfectly healthy animals. The test simply shows that the individual has the bacilli in him. It is said that

in man 90 per cent of town dwellers have tubercles in their system at one or other stage of growth or which are dormant or show signs of abortive attacks on lung. It is said that in Great Britain about 80 per cent of the dairy cows have tuberculosis in the system in any stage as against 40 per cent in all cattle taken together. Where the infection is so widespread, the tuberculin test becomes a routine necessity for watching the continuance of the disease.

There are various measures of dealing with the disease according to the seriousness and predilection of the various countries. In Great Britain, as has been observed, they attempt to stamp out the disease, one way of which is to kill the positively affected animals showing outward clinical signs. Another method is to encourage dairy men to keep their dairies clean of the disease by awarding prizes. In Great Britain milk from tubercle-free herds is sold under licence under a special designation. The herds are subjected to tuberculin test every 6 months. According to a 1934 Regulation the owners of herds which are completely free from tuberculosis are not only granted a certificate but a bonus also on the milk produced. The test in the latter case extends to the whole herd and not limited to the dairy herd only.

Immunisation : Various methods have been tried but none very satisfactory has as yet been evolved. The one claimed to be most successful is the B. C. G. vaccine. B. C. G. is Bacillus Calmette and Guerin. Calmette, Guerin and others worked and found that by long-continued culture on potatoes, the virulence

of bovine bacilli is so attenuated that it does not create tuberculosis in cattle but serves to immunise the cattle for sometime. The results have been proved to be positive. But the immunity diminishes fast after about 6 months, and almost no immunity may be left over after one year. Annual re-vaccination does not seem to confer immunity in all animals, a large percentage being left unimmunised after the first or second year, although they may have received two to five repeated inoculations at intervals.

Another difficulty with this B. C. G. immunisation is that the animal responds to tuberculin test all the time so that animals for prize or shows cannot be put under it.

In this country the way for restricting the spread of the disease would be to have the herd tested with double dermal tuberculin test and the open ones microscopically. And then divide the herd in 3 parts. Those that by their cough, emaciation or open tuberculosis test show that they are positively affected and are also visibly affected should be kept separately in isolation enclosure as Group A.

Those that show positive reaction to tuberculin test but do not show any clinical sign of disease should be kept separately for watch as Group B.

The third class will form the non-reactors to the tuberculin test and compose Group C.

Treatment : The animal of A Group should be given natural treatment, nutritious food, rest and sun-shine, and if possible pasture, if it can be exclusively arranged for them. Group B should be

watched and any one developing signs of tuberculosis should be transferred to Group A. Tuberculin test should be made in this group every 6 months or every year to see if some have naturally improved.

The I C. A. R. recently held a survey in Madras and Mysore which showed that T. B. in animals was of rare occurrence except in the conservancy bullocks at Madras in which the disease has existed for a number of years. The relative infrequency has been attributed to the lesser virulence of the Indian strain of tuberculer bacilli and the greater resistance enjoyed by the Indian cattle. The I. C. A. R. proposes to go deeper into the matter and test the correctness or otherwise of the above opinion. The report of I. C. A. R. 1941-'42 mentions, as found at the Government Cattle Farm at Hissar, that whatever be the factors for the comparative rarity of tuberculosis in India, the disease can assume quite serious proportions once the conditions favourable for its spread are introduced.

1393. JOHNE'S DISEASE

Synonyms :—*Paratuberculosis, Paratuberculous enteritis of cattle, Chronic bacterial enteritis of cattle, Chronic pseudo-tubercular enteritis of cattle.* **Hindi**—*Vah, Dast.*

It is a chronic, infectious disease of cattle causing inflammation primarily in the small intestine, and resultant diarrhœa characterised by emaciation. It is caused by an acid alcohol-fast bacillus resembling tubercle bacillus.

Occurrence : This disease is of world-wide prevalence. It did not draw much attention in India previously. It is now known that it is widely prevalent in India. In Great Britain it is next in importance to tuberculosis. But in India it is much more important than tuberculosis. Men are not infected by it.

Bacteriology : Johne and Forthingham in 1895 found that this diarrhoœa is caused by a bacillus which is rod-shaped like tubercle bacillus but is smaller and slightly curved. After Johne this disease is known as Johne's disease or paratuberculosis. It has more than mere resemblance to tuberculosis.

The bacillus was difficult to be cultured outside animal bodies, but now a way has been found out. The bacillus *Mycobacterium paratuberculosis* could be induced to multiply in cultures containing dead human-tubercle bacilli or other dead acid-fast organism. Now it has been found that after several cultivations,

containing acid-fast bacilli, it can grow in a medium without the addition of dead acid-fast bacilli. Synthetic media are now being employed.

Infection : Infection takes place through the mouth by the ingestion of materials containing live bacilli which are voided with the fæces of an infected animal. After infection the disease is very slow to develop and no clinical symptoms may appear in two years after infection. It is believed that not all the animals that are affected develop definite symptoms. Infection may occur in pastures, through pools, puddles, contaminated by the fæces of affected animals. The bacillus may propagate in the open in a natural condition and is not easily injured by external influences. A pasture once affected may continue to be dangerous for weeks or months.

Susceptibility : Young animals are specially susceptible. But clinical manifestations are observed in the cows at the age of 3 to 6 years. The disease, remaining latent for years, may be manifest when the vitality of the animals or their resisting power is reduced. For this reason it has often been manifestly seen in cows in a few weeks after calving. In oxen and bulls it occurs rarely. Even in them exhaustion or fatigue may be traced to be the cause of the appearance of the disease. A deficiency of minerals is regarded as one of the most potent contributory causes of the disease.

On reaching the alimentary canal the bacilli penetrate the mucous membrane and cause enteritis. One special characteristic is the thickening of the

mucosa. Sometimes their pressure leads to the atrophy of the intestinal glands.

Symptoms : As has been mentioned, the disease progresses very insidiously. The initial symptoms are loss of appetite, reduced milk production and gradual emaciation. After some weeks or months the characteristic symptoms appear which consist of periodical and painless evacuation of a semi-fluid or watery, very fœtid fæces mixed with mucus, and often with gas bubbles. The fæces soil the animal's thighs, the walls and the floor of the stalls. At a later stage the stools become more frequent. There is a pallor in the mucous membranes. The general condition continues to remain tolerable for sometime with more and more increased loss of appetite.

When diarrhœa becomes more frequent and of longer duration, emaciation proceeds fast, anæmia develops to a high degree; the hide becomes rough and death eventually occurs. By rectal examination the affected portion of the intestines may be felt as a thick tube.

The disease runs a varied course, sometimes showing a little improvement, and again relapses. It usually runs a course of several months and may protract to one or two years. Again, cases of rapid progress of the disease and death in course of 4 weeks are also known.

Diagnosis : Where the characteristic diarrhœa rouses suspicion, the case may be confirmed by microscopic examination of the fæces when acid-fast bacilli of paratuberculosis would be found. For

examination of fæces the mucus flakes should be chosen. The fæces may be better obtained by bowel washing. The method of irrigation is described in a paper by Cooper and Srinivasan. (*Indian Journal of Veterinary Science & Animal Husbandry*; 1931, P. 215). It consists in pushing the sterile hand into the rectum as far as it will go, after having first cleaned it of fæces. A rubber tube is introduced with the hand pushing it a little beyond and then the channel irrigated out by water from a douche-can at the outer end of the tube. The wash water is collected in a basin, decanted and centrifuged for 20 minutes. The top deposit in the centrifuge tube, which consists of mucosa, is taken for microscopic test. While irrigating, the fingers should be utilised to scrape some mucus off from the remote end which come with the wash water.

In doubtful cases the diagnosis is helped by allergic reaction, induced by the inoculation of avian tuberculin or with a similar product known as Johnin. The double intradermal test, as in tuberculosis, with Johnin is reputed to give satisfactory results. Allergic test in paratuberculosis, however, does not give the certainty that tuberculin gives in tuberculosis. In the case of paratuberculosis, when positive reaction is found, it is diognostic, but a negative reaction does not rule out absence of infection. Minett, (*Indian Journal of Veterinary science & Animal Husbandry*; December, 1935, P. 389) by the use of Johnin, in double intradermal test, found that out of 59 paratuberculous cattle, there were 6 cases only which did

not react. Out of these 4 were very advanced cases and 3 were tested only once.

Treatment : No method is known of effecting a complete cure. The intestinal symptoms can be relieved by means of antiseptics, styptics and by the general improvement of the health of the animal. Where parasitic diseases exist in the herd, paratuberculosis finds easy victim. In Assam certain tests were undertaken by Pande who found that by treating the worm-infected animals, by cleaning them of parasites and by the use of mineral supplement to diet, the number of cases of Johne's disease decreased. Good results had been obtained in the Mukteswar herd also kept under observation for Johne's disease and treated with mineral supplements. A paratuberculous herd kept for 10 years mixed with healthy cattle at Mukteswar has recently been broken up without coming to any very definite conclusions. In a paper Ware and Srinivasan deal with the Mukteswar experiment. (*Indian Journal of Veterinary Science & Animal Husbandry*; December, 1941, P. 289).

The inference drawn by the authors is that Johne's did not spread in the herd in the way it was expected, because of the naturally healthy condition of living. They opine that under good farming conditions the disease spreads easily—

..."(*a*) when there is a high level of infective material within a restricted space,

(*b*) when the level of host susceptibility is high, as when there is a high proportion of very young animals."...

They also opine on the Mukteswar experimental herd that ..."the danger of infection spreading could at no time have been great, in view of the high average age of the contacts and the paucity of animals suffering from the disease in clinical form. Under these circumstances some 75 per cent of the animals at the most susceptible age escaped infection. The results of the Mukteswar experiment are in general accord with those of Hagan and Zeissig (1933), who found in their six years' experience of a herd experimentally infected with Johne's disease, that even under conditions of severe exposure a considerable number of animals failed to contract the disease naturally."

They concluded:

..."Although a number of naturally infected adult animals died of the disease, and although some 25 per cent of the calves, born in the herd, also became infected and died, there was no general spread of infection under the conditions there prevailing and at the termination of the experiment Johnin testing of the whole herd and *post-mortem* examination of 6 animals selected at random indicated that the disease had disappeared.

"It seems, therefore, that in practice there is no great danger of Johne's disease becoming established in a well-managed herd, unless there is a high initial level of infection in a restricted space and a relatively large proportion of highly susceptible, i.e. very young animals, are present."

For infected animals, improvement of general health is recommended, combined with the use of mineral supplement. Where trouble from intestinal parasite exists, it should be attended to and copper sulphate and Kamala should be used as good anthelmintic agents.

Immunisation : There is no specific method of immunising against Johne's disease. In order to check the spread of disease the herd should be tested with Johnin, the positive reactors should be isolated and treated, as indicated before in the case of tuberculosis.

The treatment of diarrhœa even as a temporary measure for alleviation should be taken up.

M'Faydean found ferrous sulphate with dilute sulphuric acid to improve the condition by mitigating diarrhœa. Others have tried Methylene blue 30 grains dissolved in 1 lb. of water given in 5 doses for 5 consecutive days and then repeated after 8 days. Chaulmoogra is a specific in the case of leprosy, which also is caused by an acid-fast bacillus. Upon that clue Chaulmoogra has been used with inconclusive results in paratuberculosis. Achar (Mysore Serum Institute) in a paper on Johne's Disease mentions that Downham (1928) used Chaulmoogra upon six cases and obtained 50 per cent results, and that the curative value of Chaulmoogra was under investigation at Mysore (1939).

The I. C. A. R. has appointed a special officer for investigation on tuberculosis and paratuberculosis.

1394. ACTINOMYCOSIS

Synonyms :—*Ray fungus disease , Actinobacillosis, Wooden tongue, Lumpy Jaw.*

It is a chronic, infective disease of cattle, characterised by formation of tumours with characteristic granular bodies containing pus, usually appearing on the tongue, face, jaw, and on skin and subcutaneous tissues of face and neck. It attacks man and swine rarely.

It sometimes becomes epidemic in character. In India there are some cases found and reported. Mangrulkar gives description and plates of 10 cases pathologically examined at Mukteswar and Madras (*Indian Journal of Veterinary Science & Animal Husbandry* ; December, 1938, P. 271) at various periods.

Infection : The micro-organism concerned is *streptothrix bovis* or *actinomyces bovis.* This bacterium has the power of branching out in its growth. It grows in three forms—filaments, clubs and cocci. If a drop of pus or a scrapping from a lesion is spread on a slide and examined with the naked eye, granules are observed. If these granules are crushed and observed under low power in a microscope, they will be found to be filamented bodies or club-shaped bodies arranged in the form of a ray round a centre. The club shape is a development of the filaments which is seen in an early stage. Cultures develop at ordinary body temperature in albuminous media.

It has been suggested that the bacilli are obligate parasites of human and animal body and inhabit the digestive canal and possibly also the upper air passages. The disease may, therefore, develop of itself in the body through a break in the mucosa of the region. Such opportunity is offered, for instance, at the change of dentition and in the course of foot-and-mouth disease and other infective diseases which affect the mucous membrane.

Sharp particles of corn etc. in food play an important part. When corns with barbed points enter into soft parts like the tongue, they remain broken there and are continually driven deeper by muscular contraction. They create canals which favour the entrance of actinomycotic organisms into the tissues. In the alveoli of the gums, by a similar process of entrance of sharp barbes the organisms may find entrance and create actinomycosis of the jaw. Actinomycosis of the udder may occur similarly through injury done by sucklings.

Symptoms: In cattle the tongue is most frequently affected, and next in order are the jaw bones. If the tongue is affected, raised nodules which are firm and hard are at first formed. These extend inwards and fibrous tissues are proliferated so that the tongue becomes hard like a piece of board and protrudes, which gives the name 'wooden tongue' to the disease. It becomes difficult for the animal to utilise the tongue for gripping food and there is a danger of starvation. Some times the jaws, particularly the lower jaws, are affected. Spongy

cavities are formed and the bone, distorted out of shape, becomes brittle and is filled with products of the changes worked on by the bacilli. The pharynx may also be attacked and a growth of tumour may take place there.

The skin and subcutaneous tissues in the region of the head and the neck may get affected and show tumorous growth.

The disease runs a chronic course covering months and years. It begins insidiously, specially when affecting the bones. It becomes evident when outward changes occur or when nutritional or respiratory difficulties develop. So long as the disease is localised there is no rise of tempersture. When suppuration and septic condition reaches the blood, then there is fever.

Treatment : When the tumour is only an outgrowth and can be separated, the excision of it is the quickest method of treatment. When the seat of disease is unfavourably situated for excision, it can be deeply incised and the offending materials scraped or scooped out and then filled with antiseptics, preferably iodine gauge. Outside the buccal cavity the tumour may be punctured at the apex and pus scooped out and 15 to 30 grains of arsenic in a gelatine capsule in the form of bougie inserted into the canal. This causes necrosis of the mass of the tumour which gets gradually detatched, after which the wound heals. Actinomycosis of the tongue in early cases can be treated by incisions at the sites, followed by painting with tincture iodine. Iodine injection

at the site is also a good method where incision is not possible.

Iodine intravenous injection 200 c. c. of a 5% iodine solution (for adults) should be very useful. This is particularly effective in affection of the tongue, larynx, skin and subcutaneous tissues. When the bone is extensively affected, the internal use of iodine is not of much good. In Great Britain the oral administration of iodine is practised whether surgical treatment is applicable or not.

Potassium iodide is also administered. For young cattle, the dose is 30 grains to one dram. In mature animals the dose is doubled. One dose is given daily with drinking water, for 2 to 4 weeks till all the tumours disappear. Use of iodides and iodine in large doses may bring about iodism which is indicated by nasal or conjunctival catarrh, cutaneous eruption, falling off of hair and emaciation. In such an event the treatment should be suspended for few days and then recommenced with smaller doses. The effect of the internal iodine treatment may be enhanced by painting the tumour, specially in the case of the tongue, with tincture of iodine and by the injection of iodine and potash iodide solution in the growths.

1395. BANG'S DISEASE

Synonyms :—*Brucellosis, Contagious abortion.*

In contagious abortion one animal after another may abort without any external injury to the cows. The disease is caused by *Brucella abortus*, a bacterium which can pass on from cow to cow through food contaminated with the bacilli.

The term *Brucellosis* is a general one, meaning disease caused by brucella. Brucella of one type causes malta fever or undulent fever in man; another type causes abortion in cattle and a third causes abortion in swine. The three have now been differentiated and named as *Brucella melitensis*, *Br. abortus* (cattle) and *Br. Suis* (swine).

Brucella abortus needs an anaerobic atmosphere. For laboratory purpose it can be made to grow on pure culture in an atmosphere of carbon dioxide.

The bacilli in cultures may remain virulent even for 2 years. In the interior of the uterus, and in dead fœtus they remain virulent for months. Sunlight kills them soon. In the fœtal membranes, in shade and in cool weather, they live for 4 months. In dry air at 50 to 55°C., they die in about 2 hours. The usual disinfectants kill them in a few minutes.

When the bacilli enter the system through food or by contact of the reproductive organs with the live bacilli, the disease does not at once produce abortion in pregnant cows. Indeed, in many cows they may not induce abortion at all.

Brucellosis is very prevalent where cattle-breeding is carried under intensive conditions. It occurs in India. At first, for want of attention being drawn to it, cases were considered to be infrequent. But now that attention has been focussed on the disease, many herds are found to be affected and the disease is believed to be widely prevalent. In some countries 40 to 60 per cent of the cattle are infected. It is as widespread in North America and South Africa as in India. It causes great economic losses to dairy farms, the animals being rendered partly sterile, because cows after abortion either conceive with difficulty or do not conceive at all. After an abortion, 2 years may be safely taken as the interval before the cow may come to heat again unless special care is taken.

Infection more often spreads during and after parturition of pregnant cows. They then throw off the brucellæ in large numbers in the discharges of *liquor amnii* and other membraneous and mucous discharges. When this takes place, food, straw, water etc. in the neighbourhood get contaminated. Males may be affected and communicate the disease during coition. It is now believed that infection can take place even through the skin by a cow lying down upon particles of discharged materials from an infected cow.

The bacilli on reaching the system lodge in the lymph glands. They have a special attraction for the embryonic tissues of the fœtus and the maternal placenta. In pregnant cows the entry of the bacilli thus causes disturbance which may result in abortion

or in weakening of the fœtus or in premature delivery of the calf.

As the bacilli may get lodged in the tissues of the udder, they may affect the fœtus at the next impregnation from there, and abortion may occur without a fresh infection from outside.

In cases of abortion, the placenta often does not come out. If it is retained, it may cause secondary infections through putrefactive and pyogenic bacteria. These may cause inflammatory changes in the uterus and may sometimes create general septicæmia. It may be noted here that if in case of abortion, whether due to brucellosis or not, when the placenta is not found, it would not be safe to assume that the cow has eaten that up, as they very often do. In every such case an internal examination should be made. In cases of natural delivery attendants take care to remain present and see that the placenta comes out. But abortion is an unexpected thing and if occurring at night, the attendants see it only in the morning. Absence of placenta on the floor is easily accounted for by the supposition that the cow has eaten it up. No internal examination is usually made. The cow retaining the placenta shows emaciation, loss of appetite, and the foreign material remaining in the uterus continues to create mischief. Blood may be affected giving rise to septicæmia, and the cow may die. On such occasions of abortion when placenta is not found, it would be wrong to merely wait on. An internal examination must be made, and if the placenta is left in the uterus it should be brought out by manipulation.

Symptoms : In cows the most prominent symptom of the disease is abortion. Abortion may take place at any period of pregnancy; but commonly it takes place during the sixth to eighth months. Sometimes it occurs later, and sometimes so early that the expulsion of the embryo may not be noticed at all.

When in spite of affection of the fœtal membranes the calf is born at the usual term, the disease can be recognised by the changes in the placenta or by microscopic examination of the discharged materials. In such cases the placenta is usually retained.

Early aborted calves are usually found dead. In later abortions the calf may be born alive, but it usually dies in one or two days through septicæmia of the new born (**1401**). The calf of an affected cow, born alive, may occasionally live.

Course of the disease : When the abortion is clean or there is normal calving even when brucellosis was detected by test, the cow usually recovers and is capable of conceiving again. After renewed conception she may calve normally or again abort and that repeatedly for the third or fourth time. But she may also give birth to calves that will live.

Those cases in which the placenta is retained or not expelled smoothly and immediately, may develop after-effects which though not connected with brucellosis, may make the animal sterile. Sometimes the œstrum is interfered with.

When a herd becomes infected for the first time, abortions occur at long intervals, and later on in rapid succession. At first only a few animals may be

affected, and when these abort the infection is spread rapidly in the herd.

In the herd in which renewal by purchases from outside is not made and replacements from that herd are not made, the disease dies out gradually, because animals after one or more abortions acquire sufficient immunity to resist further attacks. But in uncontrolled herds, having the infection, if new heifers are brought in, they get affected and keep up the infection. Even when herds are supplemented by their own progeny, periodic cases of abortion continue to occur, as the heifers also abort till they get immunity. The course for allowing the disease to die out naturally is to cease to replace cows for sometime. When the herd is free of the disease, fresh cows and heifers may be taken in.

Diagnosis : The disease can be diagnosed by the agglutination test. The blood of the animal is taken and tested for brucellosis by the agglutination treatment. When the brucellæ become located in the uterus, their multiplication cannot be prevented, and for the same reason the death of the fœtus cannot be prevented.

In case of cows that have aborted or calved at full term in spite of the infection, the first attention should be paid to the placenta, as the placenta is usually retained in such cases. Any retained placenta should be removed and the uterus should be washed out with a 0·9 per cent solution of common salt in boiled sterile water. This is to be continued till the fluid comes out clean. This treatment is to be given daily, later every

2 or 3 days, till after the discharge has ceased. This usually takes about 2 weeks. The cow, if it comes to heat, is not to be served till 2 months at the earliest after the abortion, when the uterus will be free from infectious materials.

If the uterus is inflamed, local treatment is necessary after evacuation of accumulated rotting materials and repeated irrigation with syphonage.

Prevention : To prevent infection in a clean herd, it should be maintained from its own progeny. If this is not possible, newly purchased animals should be kept separate and tested by the agglutination test undertaken at least 3 weeks after purchase.

If in a clean herd an abortion unexpectedly occurs, or the retention of placenta occurs, it should be treated as a case of brucellosis, until proved to be due to other causes. The animal should be isolated and the stalls and grounds thoroughly disinfected. The fœtus and fœtal membranes after examination should be destroyed.

The disease produces anti-bodies in the system so that as in other infectious diseases there is room for inoculation for securing immunity. This has been tried on a mass scale, but the opinion now is against vaccinating for brucellosis. Not only is it in itself of doubtful efficiency, but once introduced, vaccination is to be carried out every 6 months. This is not recommended.

The only and the most successful method for checking further infection in an affected herd is to take hygienic measures. The cow-shed should be

thoroughly disinfected. A separate, light shed should be erected of inexpensive materials temporarily for the calving of affected cows. It is during the calving period and for some weeks after that the cows become infective. The parturition should be in this isolated structure. Any cows showing symptoms of abortion or premature delivery should be removed there. After the birth of the calf or the abortion, the cow should be thoroughly cleaned and disinfected, and all discharged materials buried or burnt. The floor should be lightly burnt by thinly spreading a layer of straw. The shed may be burnt.

After birth it is to be seen whether the placenta comes out or is retained. In case of retained placenta, proceed as already indicated. Keep the cow in the shed so long as any discharges come out. When she is perfectly normal she may be brought back to the herd.

In all cases irrigate the vagina with non-irritating fluids, such as *neem* leaves lotion in water.

For calving of other cows a separate shed is recommended, and not in the byre where all cows are kept. The herd should be examined, if possible every year, with agglutination test for the presence of *Brucella abortus*. The test may be carried out without the use of a microscope. The separation of infected and probably non-infected cows, if possible, would be a wise procedure. The same byre may be used with a partition. In this way the side containing non-infected animals will grow in strength, and the infected side will ultimately be eliminated, provided only tested progeny are kept. For test see para **1392**.

1396. TICK FEVER

Synonyms :—*Bovine piroplasmosis, Red water, Black Water.* **Hindi**—*Zard bukhar, Lal pishab* ; **Bengali**—*Rakta mutra* ; **Gujerati**—*Mootar-ma-lohi* ;

Bovine piroplasmosis or tick fever is a disease of the cattle of tropical and sub-tropical regions, caused by the infection of blood by the piroplasma *Babesia Bigemina*, transmitted by the bite of the tick *boophilus.*

This protozoal parasite causes profound alteration in the blood, causing fever and red colouration of urine. The name red water comes from the red colour of the urine, although all cases of tick fever may not show red colour in the urine.

The disease is common in India.

Under the microscope, the parasite in blood looks like large, pear-shaped circles, containing a cytoplasm which is stained blue by any of the ordinary blue stains. The pear-shaped parasites often appear in pairs, the pointed ends facing each other.

Experimentally the disease may be transmitted by the direct inoculation of infected blood after it is defibrinated. After recovery the animal may remain a carrier for years. The piroplasms remain in the blood, but under the immunity evolved, due to the attack, they cannot multiply.

Life cycle of the tick boophilus : The boophilus are hatched out in grass from the ova. The six-legged larvæ then pass on from the grass to the body of the cattle to suck the blood and develop through its

stages of growth which it completes on the body of the animal. In a few days the larva changes from brown colour to white, and moults in 5 to 12 days. After moulting it is transformed into the 8-legged nymph stage. In 5 to 12 days it sheds its skin and becomes mature.

The male becomes a brown oval tick about $\frac{1}{10}$th inch long. The female gets fertilised, and after that largely increases in size. In about 4 days after fertilisation it gorges itself with blood and drops off from the animal to the ground where it lays from 2,000 to 4,000 eggs. From larva to the egg-laying stage it is about three weeks, depending upon the atmospheric temperature. Suppose, the female tick had sucked piroplasma-infected blood, then the larvæ get the piroplasma in them and the developed ticks are infected ticks, and when they bite the host, piroplasma is injected into the blood, infecting the animal. The fever is, therefore, confined to localities where the ticks are naturally present as also the infected cattle. The infected areas are limited to shrubby and wet places. Cattle from infected areas do carry piroplasms in them for 10 or 12 years or throughout their life time, and are, therefore, a source of danger to an uninfected area where the ticks may be present but no infected cattle.

Susceptibility : The young calves are most susceptible and soon get infected after birth where the disease and the ticks are prevalent in a herd. The principal characteristic is that on infection the calves show slight fever and even fever may not

in all cases appear. The calves do not die. After infection they remain immune but usually become carriers.

Symptoms : In animals, carrying the piroplasms and enjoying immunity, there may be a breakdown after any severe or debilitating disease such as rinderpest or foot-and-mouth disease. The cattle then develop piroplasmosis; the parasites in the blood multiplying cause symptoms to appear in an acute form.

The disease may occur in an acute and a chronic form. The symptoms of an acute attack are high fever 106 to 107°F.; there is constipation at an early stage, followed by diarrhœa, or dysentery and the red colour in urine. The urine becomes coloured, and might appear from a tinge of blood to blackness. The animal becomes anæmic and jaundice may appear. Diarrhœa may show blood clots and mucus. Milk secretion is diminished. The milk sometimes becomes yellow in colour. Pregnant cows commonly abort.

The hind limbs become weak at a later stage and the animal moves with shaky, oscillating or staggering gait. Muscular tremors appear. The flanks become sunken. The skin becomes rough and dry. Discharge flows from the eyes. The mucous membranes become dry at first, then icteric. The pulse is accelerated and by slight exertion rises to 120 to 160.

The blood becomes abnormally bright red in colour and shows more fluidity. After clotting, the serum shows a reddish colour. If a blood count is taken the red corpuscles are found to have diminished to

$1\frac{1}{2}$ millions per c.c. and are interspersed with the parasites, the number of which vary according to the severity of the disease.

In cases running an unfavourable course the animal becomes so run-down that it cannot stand and continually remains lying down. Breathing becomes difficult. The animal moans in pain. There is lachrymation, salivation and tremors of muscles in continually aggressive form. The temperature rapidly falls to 98°F. and the animal expires. In mild attacks, the symptoms are not pushed so far. The temperature does not drop down suddenly, but there is a gradual fall. Appetite and strength slowly return, red corpuscles increase. Recovery takes months.

The chronic form sometimes develops at the termination of an acute attack or it may develop in a healthy animal insidiously. The temperature rises to about 104° and generally remains within 105-6°F. Anæmia and emaciation are gradual. The urine is not discoloured and contains no haemoglobin. The disease runs a course of several weeks, and recovery may take some more weeks or months, and relapse may occur with slight rise of temperature.

The acute form generally terminates fatally, mortality being highest during the summer months. The chronic form is seldom fatal, unless complications arise.

In very young calves an attack may pass off without drawing any attention. In calves under nine months of age, the disease lasts only a few days. In young animals from 1 to 2 years of age the mortality may be

25 per cent. Cattle recovering from one attack are usually immune to further attacks.

Diagnosis : The characteristic appearance of hæmoglobinurea, rise of temperature and icterus may help to diagnose correctly. When there is no hæmoglobinurea, but only a rise of temperature, but other cattle in the herd exhibit typical symptoms, the assumption will be for piroplasmosis. A search for the ticks may be helpful in diagnosing. A microscopic examination can give a definite diagnosis by revealing the presence of the parasites in the blood.

Both anthrax and hæmorrhagic septicæmia show symptoms in many points common with tick fever; but in those cases the course of the disease is more rapid, and anæmia is absent. The urine is not red and œdematous swellings are present.

Even in autopsy without microscopic examination, the dark colour of anthrax blood will differentiate it from the red blood of tick fever.

Treatment : Treatment is possible, and if undertaken early the chance of recovery is indeed very great. Recovery, however, does not mean destruction of the parasites from the blood. The animal may continue to harbour them, and does so generally.

Trypan blue, an aniline dye of benzedine series, is a specific. The blue in solution is to be introduced intravenously. There is a transient rise of temperature, but in a few hours the disease comes under control, the urine becomes clear and the parasites either disappear or become considerably less in number.

Good results are obtained by intravenous injection of 1½ to 3 grains of trypan blue per 200 lbs. of body weight. The injection should be performed carefully, as the blue getting in subcutaneously may cause suppuration and even necrosis. It should be repeated in 6 hours or 24 hours if there is no improvement. Trypan blue is dissolved in normal saline, the strength being 1 to 5 per cent. The injection causes bluish grey colouration of the tissues. If necessary the injection can be repeated. The blue

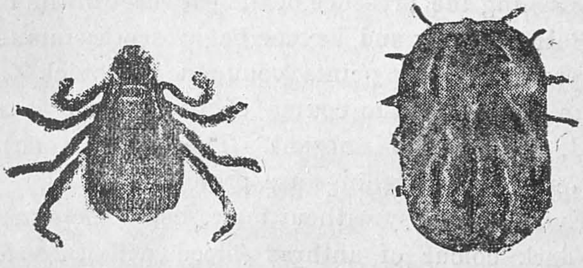

A. B.

Fig. 104. Boophilus annulatus.
A. Male ; B. Female.

may soil the hands. A little calcium chloride and hydrosulphite will remove the stain. At present Trypaflavin is used with even better results than trypan blue. The dose of trypaflavin is 15 grains for adult and 7 grains in 50 c. c. of normal saline intravenously for young animals.

Trypaflavin is sensitive to light. The treated cattle should not be exposed to the sun and should be protected from strong light for a few days after the injection.

Symptomatic treatment for diarrhœa in anæmia should be carried on along with the trypan blue or trypaflavin treatment.

When the animal is very anæmic on account of the loss of hæmoglobin and is debilitated, intravenous injection of normal saline is recommended. In constipation saline aperients may be given as also opium in case of diarrhœa. 1 to 2 drams of iron sulphate may be given daily in gruel for anæmic animals.

Immunity : Immunity is hardly necessary in naturally-infected areas, for, the calves generally get the disease early in life and remain immume. The difficulty comes when affected cattle from endemic areas are taken to clean areas. There, they affect others and the consequences may be serious. Again, if cattle from clean areas are brought into endemic areas, such cattle may fall victims to the disease and die. The crux of the thing is to attempt to immunise the cattle when they are calves by injection of a few c.c. of defibrinated blood from an affected animal or from a carrier. When adult cattle have to be imported into an affected area, they may be immunised as above, and the reaction when passing the limits should be controlled by the injection of trypaflavin or trypan blue.

1397. SURRA

Synonyms :—*Trypanosomiasis.* **Hindi**—*Surra, Tinsala, Zahrbad.*

Surra or rotten is the name given to a disease which is a specific remittent or intermittent fever due to the infection in the blood by a parasite, *Trypansome Evansi,* characterised by pernicious anæmia and wasting.

It is chiefly a disease of the horse and camels; sometimes dogs are also attacked. Cattle and buffaloes are infected, although disease symptoms are

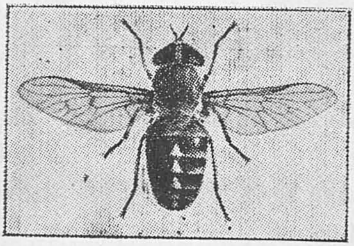


Fig. 105. Tabanus bovinus.

slight in them and they mainly play the part of carriers. When any cattle or buffaloes are severely attacked they can be cured easily, while in the horse and camels the disease often turns fatal.

The disease has a seasonal appearance. The infection is carried by a vector usually the flies *Tabanus* and *Stomoxys.* They bite affected animals and mechanically carry the infected blood in their proboscis to the next healthy animal that they bite.

There are other vectors too. The disease prevails after the rainy season when in moist lands the flies concerned are hatched in abundance. In affected areas there are surra zones and also surra seasons. The parasite belongs to the family of trypanosomes. There are several trypanosomes causing different diseases.

Surra : caused by Trypanosome Evansi.

Nægana : affecting all animals specially horses and camels, caused by Tsetse fly carrying Trypanosome Brucei.

Gall sickness (of cattle) : In Africa due to Trypanosome Theileri.

Sleeping sickness (in man) : Caused by Trypanosome Gambiense.

Trypanosome Evansi surra is a large, blood parasite. It is motile and can be easily detected in the blood if immediately tested after taking it. It makes slashing movement. It is three to four times the size of blood corpuscles. It does not directly absorb or destroy blood corpuscles, but the materials from the corpuscles pass on to these by osmosis which they absorb for their nutrition. Blood thus becomes poor and is unable to maintain life on account of anæmia and wasting. They multiply by division, and so create immense mischief in cases where they get fields for unchecked growth.

Symptoms : The animal shows high fever, dullness, the hairs are on end, and discharges flow form the eyes. After a time the multiplication of the parasites diminishes and the animal becomes better. It again recurs after an interval of a few

days or weeks. Attack after attack, after respites, may follow. The animal becomes emaciated. There is wasting and dropsy. Finally the animal succumbs. These are the symptoms when horses and camels are infected. In the cattle and buffaloes the disease rarely takes so serious a turn. The parasites disappear from circulation when there is no fever and reappear during fever. In cattle there seems to be a stage of equilibrium when the parasites are unable to multiply. The cattle and buffaloes in India form store-house of infected blood, to be used by the flies in season for infecting other animals.

Occasionally virulent outbursts occur amongst cattle also in India. The mortality rate may, under these circumstances, rise to 50 or 60 per cent. The disease rapidly progresses and the animal dies after a few attacks of fever. The incubation period is 4 to 8 days.

The disease can be diagnosed definitely by examining the blood during fever under a microscope. The disease in the cattle and buffaloes can be easily checked and cured.

Treatment : It consists of *intravenous* injection of tartar emetic. The dose is 3 per cent solution of the substance, 5 c.c. for every 100 lbs. body-weight. If there is a relapse, another dose is to be given. It may be usefully supplemented by the administration of daily doses of arsenious acid with a small beginning and increasing to 15 grains in two doses by mouth in a day. In horses and camels tartar emetic is not of much use. The German preparation, Naganol or Bayer 205, is effective in those cases.

Prevention : When several animals amongst the cattle show intermittent fever and emaciation, an outbreak of surra should be apprehended. The affected animal should be removed to some distance, so that flies from there may not come and infect the healthy cattle. If possible, the blood of the suspected animals should be microscopically tested. If the disease is confirmed, treatment with tartar emetic should commence. Tartar emetic may be administered on suspicion of infection without blood examination.

1398. TETANUS

Synonyms :—*Lockjaw*. **Bengali**—*Dhanushtankar*.

It is an acute, infective disease arising from infection through wounds in which the toxic effects react on the nerve centres causing persistent spasmodic contraction of muscles. The disease is due to the entrance into the animal body of the anaerobic *bacillus tetani* (*clostridium tetani*). It is not a contagious disease spreading from animal to animal. It is usually met with in isolated cases.

The bacilli tetani sporulate. These and their spores are widely distributed in nature and are found in soil, dust, water, manure, drains, floors and also in the alimentary canal of healthy animals. When they find entrance into a wound they cause tetanus. The bacilli remain localised strictly in the wound. From there they create a toxin which gives rise to the symptoms of tetanus. The toxins have an attraction for nervous matter and operate through the nervous system. From the wound the toxin travels to peripheral nerves and thence react on the central nervous system. It may, in severe cases, be carried by the blood stream to the brain and the spinal cord through the nerve endings.

The spores in a dry state remain alive for years and can live week after week in putrefying materials. They are killed by boiling.

The blood and tissues of infected animals are not infective. Materials from infected wound are infective.

The infecting bacilli are present in the soil. Cuts on the skin, wounds, puncture by nail, may all become infected. Punctured wounds, or wounds associated with the destruction of tissue are more favourable for receiving infection. Wounds on feet which are liable to come in contact with earth or dung are most liable to be infected. The umbilical cord of calves or babies is a favourite place for the infection to take place. Infection may occur through injuries in the mucosa of the mouth which may not be visible. Cattle may get infected occasionally through mouth by chewing hard materials contaminated with the bacilli. Tetanus may occur in cases of decomposition of retained placenta.

The incubation period is varied. In young animals the period may be as short as 24 hours, while in the majority of cases in the ox the period is 2 to 15 days.

Symptoms : The disease, even at the early stage, causes a rigidity of muscles, characterised by slow movement, sluggish mastication and slow swallowing of food. The joints do not flex readily. The rigidity rapidly spreads over the body and the characteristic symptoms appear. There is a peculiar projection of head, and the feet are spread out. The animal can walk only with difficulty. Turning becomes difficult. They turn with the body held stiff. Backing is often impossible. The ears become erect and the eyes do not move, the pupils get dilated, the nares become expanded. The muscles show spasm. The jaw becomes locked. The spasm of the pharyngeal muscle prevents the swallowing of saliva which hangs from the mouth.

The abdomen is contracted, causing retention of fæces and urine. The tail is stiff and not movable and is drawn to one side and somewhat raised.

The muscles feel as hard as board and the contours come out in clear definition. The slightest touch causes excessive stimulation, and spasms occur. A ray of light, a noise, an attempt to move causes such spasm that the animal often falls down stiffly and may injure itself. The convulsive spasms periodically

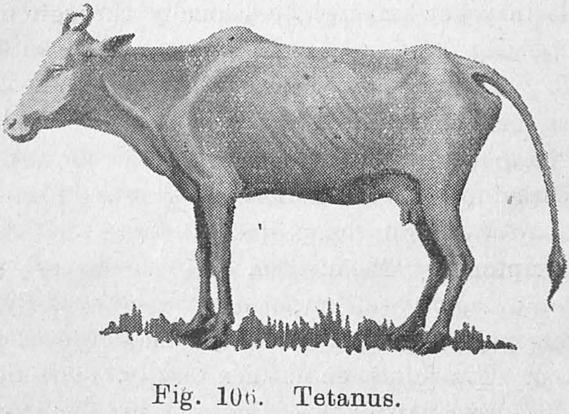


Fig. 106. Tetanus.
General muscular rigidity in a cow.

cease and again begin. Spasms are accompanied by profuse sweating. Respiration is difficult and incomplete, resulting in cyanosis. There is a slight rise of temperature, but continuous spasms elevate it. Before death there is almost continuous spasms, and the temperature may rise to 105 to 107°F. Similar symptoms occur in strychnine poisoning, and part of the stiffness is evidenced in case of rabies, in meningitis

and in rheumatism of the neck. In cows, tetanus often occurs after parturition, specially when there is retention of the fœtal membranes.

Course : In the majority of cases, prognosis is unfavourable when the disease appears rapidly after infection, say within 6 days ; it generally terminates fatally. When the disease takes a long period of incubation and then the development is slow, the outlook is more favourable. If the animal survives the second week and no complications occur, recovery may be expected.

In the cattle the disease is less virulent than in horses, and the mortality is 70 per cent as against 75 to 85 per cent in the case of horses.

Treatment : Anti-tetanus serum is not really effective in animals. Very large doses have to be used at prohibitive cost, and even then in advanced cases there is no appreciable effect. Once the disease has got a hold over the central nervous system, the serum cannot detoxicate. It can only check further spread. In the earliest stages serum may do some good in 50 to 100 c. c. or more doses by the intravenous route.

Palliatives are only indicated. The animal should be allowed to remain quiet with as little disturbance as possible for feeding or administering medicine. So long as it can swallow, give some gruel, milk, etc. Strength has to be maintained. Cold water should be placed near for drinking. The watering and feeding utensils should be placed at the level of the head.

If the wound is found, dress it antiseptically. Try to relieve the bowels by enema. Carbolic acid treatment is said to do some good.

Carbolic acid ... 1 dram,
Warm water ... 2½ ounces, make 5 per cent solution.

Inject subcutaneously when cold into the neck or shoulders every 2 hours during the first 32 hours and then less frequently. As much as 36 drams may be injected in 24 hours. A special tolerance for carbolic acid seems to be developed in this disease. Carbolic acid may be alternated with Lugol's solution intravenously.

Chloral hydrate 1 to 2 oz. may be given daily per rectum. Morphine 3 to 4½ grains may be given subcutaneously. Intraspinal injection of novacain, 50 c. c. of 1 per cent solution was found to cause improvement and recovery.

A subcutaneous injection of Magnesium Sulphate has been recommended. Mason reported good results with injection of 50 c. c. of 30 per cent solution of Magnesium Sulphate or ½ oz. in 50 c.c. water.

Intravenous injection of salvarsan after repeated intravenous injection of 100 c. c. of calcium chloride is reported to have made recovery possible. 17 out of 20 horses are reported to have recovered after the intravenous injection of 500 to 1500 c.c. of a 8 per cent solution of sodium bicarbonate.

1399. RABIES

Rabies is an acute, contagious and very fatal infective disease characterised by mental, emotional nervous disorders and nervous excitability with subsequent paralysis.

It is a disease conveyed by animal to animal and man, chiefly by biting. Those animals that use their teeth as weapon of offence and those others whom they attack are victims.

The bacteria is ultra-microscopic. The infection is primarily local. from which toxins are produced which affect the central nervous system. The salivary glands contain the virus after infection from which they appear in the saliva.

Male dogs are more numerous victims of this infection than the females on account of their greater fighting tendency. The incidence in them being as 7 : 1. All bites are not effective. About 20 per cent cases get the infection after a bite. The virus lives for 11 days in the saliva, if kept moist. It is active in water for 20 to 30 days. In brain matter it may live upto 2 weeks or more. Heat destroys it.

Caustic antiseptics easily destroy the virus. Mineral acids, lime juice, corrosive sublimate are specially efficient. Lime juice is said to kill the virus in 3 minutes. 5 per cent hydrochloric or salicylic acid, 10 per cent copper sulphate solutions kill the virus in 5 minutes.

The incubation period is very varying, and the sooner the symptoms appear after incubation, the

greater the danger to life. In dogs the period ranges from 15 to 60 days. But it may develop even after 6 months. In man and in cattle the incubation period is from 14 to 50 days. Abnormally long periods of 5 or 6 months or even 25 months is also encountered in dogs.

When it happens that the bite is not deep enough and only the skin is scratched, then the flow of blood may wash away the virus and thus save the animal from infection. Bite from over clothes or bites on haired animals in this way may be ineffectual. Clothes may retain the saliva and the bite then may not infect. The deeper and more lacerated wounds offer chance of the virus getting strong foot-hold on the tissues. Bites on the face and head are more harmful than on the extremities. Rodents may convey the virus to cats and dogs through their bites. Animals recovering from rabies infection enjoy permanent immunity. In young animals the disease develops quicker than in older animals. About 70 per cent of bitten animals develop the disease in between the 15th and the 45th day, about 10 per cent between the 46th and the 60th day. The rest develop either earlier or later.

Symptoms in dogs: It appears in a furious or rarely in 'dumb rabies' form. Before the dog becomes furious, the disease exhibits itself in a disposition to over-fondness, licking the master's face and hands. After that irritability and sulkiness appear. It becomes gloomy and capricious, crouch in dark places, responds unwillingly to calls. Sometimes a dog becomes

uneasy, changes the place of rest frequently or walks restlessly, and then without any cause barks and bites at the air. It gets startled without any reason and appears to be snapping at flies.

Excitability increases. There is a tendency to bite. Slight external stimuli causes fright or startling. Some dogs lick, gnaw, scratch or rub the bitten place. This is some times so severe as to tear its own flesh to the bone.

Food is rejected and an unusal hunger develops for uneatable things as leather, cloth etc. even its own excreta. Swallowing becomes difficult. The partial paralysis of the pharyngeal muscles makes it difficult for the animal to drink. The dog frequently seeks water, but swallows small quantities only with difficulty. Salivation appears at this stage. There is frequency of the attempt at urination without much success. Diarrhœa may ensue. There is excessive sexual desire, exhibited by smelling or licking of the genital organ. The look is peculiarly anxious with glaring eyes. This is the first stage.

The second stage is a stage of much more aggressiveness and may commence from after ½ to 3 days. The hallucinations increase. The dog licks the ground, gnaws at objects, tears them and swallows them. Confinement is resented. It tries to escape and roam about. If it can escape, it will bite any dog without provocation. In the struggle the infected dog does not or cannot howl. It strives to bite specially at the head. Sheep or cattle are attacked but in a lesser degree. Men are generally not attacked ; rabid dogs

avoid men, unless threatened or irritated. The dog may return full of wounds after a course of biting and remain hiding in the house.

If confined, the fury exhibits itself in jumping against the bars. If there is a rail or any seizeable object it will gnaw at it with such force that the teeth may break. The nature of the object loses meaning for the mad dog; it will snap at and gnaw burning coal or will bite red hot iron. The attacks of rage are followed by period of depression. The animal becomes exhausted, rises and falls down. Circular movements and convulsion are observed.

Paralysis sets in. Owing to the paralysis of the laryngeal muscles barking becomes hoarser. It gives a cry which is characteristic of rabid dogs. Swallowing becomes more and more difficult. Water can be swallowed with great difficulty as reflex excitability of the muscles of the mouth occurs in an attempt to drink or even at the sight of water. This is hydrophobia. Salivation increases.

The third stage commences usually after 3 or 4 days. Paralysis becomes more and more marked and general. The mouth is held wide open, with the dry, livid tongue protruding out, and frothy saliva coming out of it. Usually the hind quarters are rendered useless by paralysis. This is the final stage of emaciation and the animal dies.

In cattle the symptoms are more or less similar, only varying according to the difference in the general structure of the two animals. Rabid cows may show unrest and excitability and an aggressive

behaviour. They may remain standing at one place with raised head and retracted upper lip. They may tear up the ground with their hoofs and horns. The fury is so great that they may break the horns. They look round with head held high and try to attack any animal, specially dogs. Outbreaks of rage continue for sometime, followed by longer and longer periods of depression. They lick or rub or gnaw at the place of bite, and such is the excitability that the flesh may be torn off. Loss of appetite, cessation of rumination, constipation and diarrhœa, convulsive contractions of groups of muscles are some of the characteristics. Sexual excitability also appears. Exhaustion increases and the animal dies in 3 to 6 days.

In the dumb form of rabies the symptoms of excitement are absent. There is neither the tendency nor the ability to bite. There is an unusual desire to examine the surroundings. There is difficulty of swallowing, constipation and weakness of the hind quarters. Saliva drips from the mouth. Water cannot be swallowed, and in any attempt to do so, it regurgitates through the nose. Death takes place at the end of the first week.

Treatment : The bite wound should be cleaned and washed, and as much blood as possible should be allowed to be run out. Flow of blood washes out the virus and there is safety in allowing much blood to flow. Immediately after washing, try to kill the virus lodged in the tissues by applying lime juice copiously and saturating the wound with it by placing lint

soaked in lime juice and pushed in. After a while the wound may be cauterised with strong nitric, hydrochloric or carbolic acid whichever is available. The lime juice, or lemon juice treatment should not, however, be omitted.

The next step for bitten men or animals is to send them to the nearest place for receiving anti-rabic injection. Pasteur introduced the method of treating with the dried spinal cord of infected animals by the injection of its emulsion. This was a preventive immunisation and not curative. The immuity lasts for three years.

Curative treatment was introduced by Sir David Sempee, the first Director of Pasteur Institute, Kasauli, India. The brain of a rabbit dead of fixed-virus infection is emulsified. (By several passages through rabbits the virus becomes uniform and is called fixed virus). The emulsion of the brain of a dead rabbit in normal salt solution is treated with carbolic acid so as to make a 1 per cent brain emulsion containing 0·5 per cent carbolic acid. The virus is killed by the carbolic acid. The treatment consists of 14 injections of 5 c.c., one each day. Vaccines requiring only 4 injections are also made now-a-days. For cattle 10 c.c. are injected subcutaneously for 14 days. There are five Pasteur Institutes in India ; at Calcutta, Bombay, Conoor, Shillong and Kasauli. In addition to these, many district head quarters are supplied with vaccine by these Institutes where treatment is carried out. The bitten animal should be treated with vaccine from the nearest available centre.

1400. WHITE SCOUR:
SEPTICÆMIA NEONATORUM

Synonyms :—*Septic affections of the new-born animals, Navel ill, Joint ill.*

A new-born calf is easily susceptible to microbial attacks. Septic affections occur in them in which more then one sort of pathogenic bacteria may be implicated. The exact bacteria or group of bacteria which cause the different symptoms have not yet been fully determined.

White Scour : It is a contagious bacterial disease of new-born calves. It occurs generally within three weeks of birth. The symptoms are severe diarrhœa, dullness and emaciation. The disease runs a rapid course—the calves usually dying in course of 3 to 10 days, after the appearance of the symptoms.

Cause : Some authorities think that the disease is caused by some varieties of *bacterium coli*, and that the bacteria enter the calves by the mouth. Others think that it is due to pasturella that cause septicæmia in grown-up animals and that the bacteria enter through the navel. Again, it is observed that calves born of aborting cows, even if kept under the best asceptic conditions, develop white scour. Therefore, *E. Coli*, *Pasteurella* and *Brucellus aborti* are thought to be responsible for the disease. As a matter of fact, any one of them singly or all of them may jointly bring about the disease.

When the natural protective mechanism in a calf is broken down by any agent, many bacteria that live

in the intestines, find opportunity to attack the walls of the intestines and become pathogenic and cause changes which become apparent in the form of severe diarrhœa.

The predisposing cause of such bacterial attack generally lies in insanitary conditions of rearing, although it is also a known fact that infection may commence from birth. Abortion is, however, not the only cause for calves of healthy mothers gettting the disease and infecting others. Rigid sanitary arrangements will undoubtedly prevent a good deal of these bacterial diseases of the new-born.

Dark, dirty and badly-ventilated calf pens should not be used. Often it happens that the calves stand on their manure for a length of time in the pens. This should be avoided. Cows with unclean, dung-soiled udders may suckle a calf and cause bacterial disease. Over-crowding in housing the calves may be one of the causes of infection. Only a few calves per enclosure may ensure cleanliness, avoid over-crowding and allow each calf to take its own food. Where it is the practice to separate the calves from the cows after birth, and feed them artificially on milk or skimmed milk, it is easy for infection to follow through the unclean vessels and through contaminated milk.

Colostrum provides bacterial-resisting capacity to calves. Calves that may not have been dosed sufficiently and for the whole of first week of birth with colostrum would be easily susceptible to infection; and care, therefore, should be taken to see that they

get plenty of colostrum. When accidentally the dam is unable to provide colostrum by death or otherwise by disease, it is a problem to save the calf from infection. Milk from other cows that may have calved about the same period should be secured to save the calf by providing colostrum. The initial insufficiency of protection due to want of colostrum is very difficult to make up. The more attention, therefore, should be given to strict sanitary feeding and rearing of calves that may unfortunately be deprived of the colostrum from their dams.

Symptoms : Diarrhœa may begin a few hours after birth. In such cases it is thought that either the aborting bacilli had found entrance into the womb, or that the mouth of the calf in coming out got in contact with fæces from its mother which may have entered it through the mouth. Whatever be the cause, when the infection begins with birth, death follows very quickly in 24 to 48 hours. In these cases the diarrhœa becomes very acute, profuse in quantity and of a yellowish or greyish white colour. It soils the tail and the thighs of the calf. The fæcal matter may even cause blistering. In other cases, diarrhœa may be frothy and foul-smelling. There may be a great deal of straining and painful moaning. The calf refuses to suck, the eyes become sunken and there is an expression of misery. The abdomen is tucked up. The back is arched. The skin becomes hard and loses suppleness. Temperature may rise at first, but as exhaustion increases and the prostration becomes more pronounced, the temperature goes down

below normal. The calf dies stretched out on the floor. Sometimes there may be convulsions before death.

Treatment : White scour is not a disease amenable to treatment. It has got to be avoided. Once the bacteria take grip and the symptoms in some measure of severity appear, there is little to be done for it.

Sun-light and fresh air should be provided from birth in addition to the measures already indicated. It has been found that in the herds where the calves enjoy sunshine with their dams, the incidence of the disease is rare. As against this, where the calves are separated from their dams and pail-fed, or where the calf pens are dark and dirty, the incidence is very high.

An infected calf should be isolated, otherwise other calves get infected and disaster follows. After one case has occurred, the temperature of the other new-born calves in the herd should be taken regularly for some days, and those showing fever should be separated.

Castor oil emulsion in one to two drams per dose is recommended for evacuation of the bowels.

Carbonates may do some good in keeping down the acidity in the intestines and also in coating the affected mucous surfaces.

Soda bicarbonate	...	1 dram,
Bismuth carbonate	...	1 dram,
Hexamine	...	1 dram,

mixed with gruel may be given, three or four doses daily. It should be remembered that medicines are

of very little use. The disease should be prevented. Stocking the mother with a profuse supply of vitamin and the calf with sufficient colostrum are the methods for preventing white scour. From January to April inclusive, the stall-fed cows due to calve at this period are given daily for a month of parturition, a supply of carrots and green feed in Scotland. The new-born calves receive their mothers' colostrum for two weeks; in addition a few drops of highly concentrated vitamin A preparation is given with the mothers' colostrum for the first nine days.

1401. NAVEL ILL : SEPTECÆMIA OF THE NEW-BORN

Synonyms :—*Joint ill, Polyarthritis.*

It is a disease of the new-born in which abscesses form at the umbilicus and at some of the joints of the limbs through the entrance of bacteria in the body by way of the unclosed navel.

There are numerous organisms concerned with the disease as in the case of white scour. Some of those which are most common are *Streptococci, Staphylococci, Pasturella, colon bacilli* and the *necrosis bacillus.*

Soon after birth and before the navel has time to shrink and close up, the opening may be exposed to infection unless precautions are taken. It has been advised to apply tincture of iodine daily to soak the end of the cord in it, to keep it free from bacteria. When tetanus bacilli enter, tetanus develops and the calf dies. When one of the above-mentioned bacilli enter they create suppuration and the bacteria enter through the wound in the body leading to the formation of further abscesses in the body, specially in the joints.

Symptoms : The disease may arise any time up to 6 months, but in the majority of cases the symptoms appear in 5 or 6 days of calving. The young animal becomes dull and does not take interest even in its dam. The temperature rises 2 to 4°F. above normal. It refuses to suckle, the breathing is

hurried. The navel is seen to be wet and blood-stained, serous matter oozes, or the navel may be dry and hot and swollen, owing to abscess formation. In course of a day or two, the joints may show swelling. These swellings develop abscesses which burst and throw out a quantity of blood-stained serous matter and pus. The calf loses condition, becomes weak and dies. Some recover, and even those that recover rarely develop into healthy robust animals. The death-rate is 50 to 60 per cent.

This disease like white scour has to be prevented by taking precautions against bacterial infection. The navel cord should be ligatured and iodine applied. Dams generally lick these off. Everytime it is taken off that way, it should be replaced. The first disinfection may be done with rather strong tincture of iodine. Then weak tincture is to be applied daily on the cord and on the surrounding skin. The pus from burst-out abscess should be removed carefully and the place disinfected and the wound dressed.

Inoculation with a polyvalent anti-streptococci serum is useful if given between the 24th and 48th hour of birth as a preventive measure in calves from susceptible herds.

1402. CALF DIPHTHERIA : BACILLARY NECROSIS

Calf diphtheria is *diptheroid necrosis* of the mucus of pharynx caused by necrosis bacillus. It leads to pneumonia and general septic infection and ends fatally.

The disease affects both the young and half-grown calves and the infection may spread. It is caused by *necro bacillus* or *bacillus necrophorus.* It is a thin, slender bacillus forming long chains and can be stained by *carbol-fuchsin.* It has to be cultured anærobically. The bacillus is widely distributed in nature, and is present in the fæces and, therefore, in the litter. From there it affects susceptible animals.

Infection occurs through ingestion of infected food and drinking water. Saliva of affected animals may carry into drinking water portions of the necrosed tissue, and if the drinking vessel is common other calves may be affected. The disease generally affects suckling calves as young as 3 days old.

Symptoms : The incubation period is 5 days after which the affected calf shows lassitude and diminished appetite. The temperature rises to 104-105°F. Shortly after this a painful swelling forms in one or both the cheeks. On examining the mouth by introducing the finger, a rough deposit is felt at the site. On opening the mouth, yellowish or grey plates are seen on the palate and on the tongue which also show swelling. Yellowish discharges come from the

nasal cavities. The pharyngeal region is also swollen. Drinking becomes difficult and the calf becomes emaciated. Cough may appear indicating affection of the larynx and the lungs. Diarrhœa may appear when the intestines are affected. The calf ordinarily dies in from 4 to 5 days, but may continue for several weeks.

Diagnosis : The thick plates on the tongue and cheek and the discharges from the nose are diagnostic.

Treatment : The mouth should be cleaned of the deposits and crusts and painted with Lugol's solution. Wash with chlorate of potash and permanganate solution are also useful. The mouth may be painted with a paste made with salicylic acid and water. Internally also Salicylic acid and Potash chlorate in 1 to 2 gram doses each may be given. Papaya milk in 1 to 3 per cent solution in glycerine may be used frequently as a paint for the hroat to dissolve off the slime and the bacteria. The affected animal should be separated to prevent spread of the infection.

1403. COCCIDIOSIS

Synonyms :—*Red dysentery of cattle.*

Hind.—*Khuni-dust, Khuni-ishal.*

It is diarrhœa with mucus and clotted blood caused by the bacteria *Coccidia.*

In India all cattle contain in their intestines these minute parasitic organism, the coccidia. Under the microscope they can be detected from mucus in the fæces as oval, round and egg-shaped bodies 4 to 5 times the size of blood corpuscles. The coccidia of different species affect various animals. Those infecting cattle are '*Eimeria Zurnii*'. The coccidia have a complex life. They invade the mucosa of the intestine and pass through a sexual and a-sexual life. For infection the fertilised female oocysts come outside the animal body and in moist soils become divided into daughter elements as spores and sporozoites. This is the egg body or ripe oocyst. This is ingested by cattle with their food and then commences the cycle inside the animal body, enormously multiplying there. The cattle in India get infected with the parasite soon after their birth. They harbour infection throughout their lives. It is useless to regard it as an infectious disease, when the infection is carried by all. But because it causes offence, care has to be taken. When the vitality is low or some other disease causes intestinal trouble, the coccidia find opportunity to largely multiply and injure the mucosa of the intestines. The disease is seen in

young animals under two years old, but may be seen frequently in older animals also.

Symptoms : The disease commences with diarrhœa. There is at first no other symptom. After a few days of simple diarrhœa, the fæces become liquid, dark green and develop very offensive odour. The fæces are thrown out involuntarily. Sometimes there is abdominal straining. The fæces get covered with small clots of blood. There is a large admixture of slime in the fluid stools. This slime shows the coccidia under the microscope. The animal becomes dull. There is loss of appetite and wasting. Rumination becomes irregular. Sometimes expulsion of large blood clots precede diarrhœa.

In about 10 days the animal recovers or takes a turn for the worse and may ultimately succumb. The disease may take a sub-acute or chronic form. Convalescence is prolonged after an attack.

In India the importance of the disease is not so much by itself but as an attributory cause of the death of animals suffering from, say, rinderpest. Certain drastic purgatives, having irritant action on the bowels, may cause the coccidia to awaken into activity. This awakening is brought about very conspicuously during an attack of rinderpest. The control of the bowels, under the influence of rinderpest, is lowered, to prevent the multiplication of the coccidia. They then begin to attack the linings with destructive effect. If the animal was recovering from rinderpest, it is observed, that even after the diarrhœa of rinderpest has ceased, there is a relapse with commencing

diarrhœa tinged with blood to which the animal succumbs.

Treatment : No specific drug is known which will kill coccidia. The treatment consists in giving palliatives by way of using astringents and disinfectants. Astringents may protect the epithelial cells. Astringents cause disinfection also, and gaining entrance into the large intestines may destroy the sporozoites.

Bismuth subnitrate ... $1\frac{1}{2}$ ounce

mixed with wood charcoal medicinal 250 grams, sprinkled on the tongue daily.

Catechu	...	2 to 3 cubes daily in water.
Thymol	...	15 grains daily.

A rapid disappearance of coccidia sometimes occurs by feeding the calves exclusively fresh and warm milk for some days.

CHAPTER XL

DISEASES CAUSED BY WORM PARASITES

1404. HELMINTHIASIS

Various kinds of worms infest the stomach, the intestines and liver etc. of cattle and cause immense loss every year. These diseases do not commonly cause serious sudden mortality, but the losses are suffered thoroughout the year. The diseases are insidious, and though they do not show high mortality in the herd by a sudden increase of death rate, the number of deaths due to secondary causes, brought on by the debilitating effect of the parasitic diseases, are enormous. The symptoms are mostly unthriftiness, wasting and anæmia. The younger animals are most seriously affected while the older ones attain a state of equilibrium in the system by restrain excercised by their tissues by which they keep the mischief, due to the worms, generally within some limits.

These diseases are more common in animals than in men because of the raw food they take. In cooked food the ova of worms get destroyed while when cattle feed on the pasture or dry fodder, the ova and larvæ of the worms find easy entrance into the body. Contaminated drinking water also is a great source of supply of the ova to the cattle. Some of them like

the hook-worm, penetrate the skin and get lodged in the organs of their selection and continue to create mischief from there.

The worms enter the mucous membrane and set up irritation by their penetration. Worms with hooks often penetrate deeply into the tissues, may perforate the intestinal wall and set up fatal peritonitis. The larger ones may form balls by agglomeration and cause obstruction of the intestine. Sometimes they travel to the bile duct and close it causing colic and sometimes death.

They absorb nutrition from the prepared material in the intestine, meant for sustenance of the host animal, and cause malnurition giving rise to anæmia and emaciation. They excrete toxins which poison the system and also cause severe anæmia. Abrasions in the membranes caused by many worms predispose the animal to bacterial infection.

The parasitic worms have a complex life history. Their lives are partly lived inside the animal. Usually it is the adult worm which is found in the bodies of animals. The adult worm lays a number of eggs, usually when it is still in the body of the animal. The eggs are excreted with the dung or thrown out with cough when they had been lodged in the lungs. The eggs thus find themselves on the ground. Under favourable condition of warmth and moisture and shade they hatch out and the embryos then pass through two or more larval stages on the ground. After which they climb up the blades of grass and get themselves ensheathed with stout capsules, and in

this condition remain more or less unaffected by outside influences of weather etc. They may remain a year or more after having reached the stage in as many as ten days after having come out of the egg and wait for being swallowed by the grazing animal to spring forth into life in a new form and procreate.

Some worms require a period of life through other creatures, snails or fishes, and have to pass through two or more changes in structure before they are fit for passing into the body of the host animal. For example, the liver fluke embryo gets into some species of snails and emerges out of it as tadpoles like organisms, swimming in water. If they chance to get a blade of grass they shed the tail, climb up the blade of grass and remain their encysted to be swallowed by animals while grazing or being carried with the grass and with dry fodder enter the stomach of the final host animal. Here they develop through successive stages and get converted into sexually adult animals.

Some, like the hook-worm, throw out eggs with the excreta which coming on the ground under suitable conditions hatch out into larvæ which creep up the feet of animals and enter the skin. And from there make their way to various parts of the body till they reach the organ of their choice, in the case of hook-worm, the duodenum. The hook-worm of the cattle in this respect are similar to the parasite in men which reach the gut through the skin in a similar manner. Different parasites have different ways of completing the life cycle, Some of them will be described hereafter.

The stock-owner should get acquainted with the life cycle and working of these parasites, so that he may take steps to avoid exposing his animals to infection as far as possible. Generally, the adult animals harbour infection by maintaining a few parasites, often in a subdued condition, in their bodies. The eggs of these are voided with their dung. The pasture becomes stocked with these eggs. In bright sun on high and dry ground they may die soon. But in moist soil, when the weather is warm, they all hatch out.

Mischief from them depends upon the number of worms getting entry. When a large number of them are ingested, they cause very severe injuries. Some of them are formidably equipped for causing injury, particularly the bigger ones and those with hooks. The small ones with such as the hook-worm when present in large numbers cause considerable loss of blood daily and also produce proportionate quantity of toxins.

Giving clean water to drink, ridding the ponds or tanks where the animal are taken to water, of molluscs and snails, avoiding pastures or fodder known to be heavily infected, are some of the means of avoiding or minimising the infestation.

Anthelmintics or poisons have been found which can kill these parasites. But the drugs used are poisons themselves and, therefore, require to be used with caution. The material that will kill a parasite will also cause injury to the tissues or cause toxic effect on the system of the host animal. There is no

royal road to getting rid of infestation with worms. The best way is to be careful and avoid risks as far as possible, specially after knowing something of the broad facts about their growth, multiplication and of habitation.

Anthelmintics that have been found to be suitable for general adoption for all classes of parasites are copper sulphate, kamala and tobacco powder. They are easily available and quite cheap. It must be said here that emphasis should be put on avoiding infestation, rather than on medication after infection.

The efficiency of different drugs upon some worms were tried at the instance of the I. V. A. R. at the Veterinary College, Punjab. The results are given in a paper by Karam Chand. *(Indian Journal of Veterinary Science & Animal Husbandry*; September, 1939, P. 287)

The incidence of parasitic diseases had increased considerably in the Punjab with the extension of the canal system. Reduction in birth rate, reduction in milk yield, reduced resistance to diseases were-increasing, and the infested animals could not withstand the hard work like the healthy stock.

Drugs were taken up for experimenting upon a batch of 24 calves and 24 sheep which were artificially infected with the larvæ of *Hæmonchus Contortus* or wire worm and *Oesophagostomum Sp.* or nodular worm. It was found that about 20 days after this infection the number of eggs evacuated, particularly in sheep, rose very high. The sheep developed a bottle jaw condition and curved back. Some of the animals

showed degenerative changes in the eyes leading to blindness in 2 months. Most of the sheep and some of the calves succumbed to this infestation. This, however, it may be said was nothing unusual. The œsophagostomum is a small, round worm with great blood-sucking capacity, and if a large number of them are allowed to live in the intestines, the animal has little chance of living long. They die of anæmia.

For finding the action of various drugs upon these infected cattle and sheep the following drugs were tried :

(A) **Single Drugs** : 1. Butea frondosa powdered ; 2. Copper sulphate ; 3. Kamala ; 4. Melon pumpkin seeds ; 5. Spineless cactus ; 6. Turpentine oil ; 7. Vernonia anthelmintica.

(B) **Combinations** : 1. Butea with Kamala ; 2. Butea with embelia infusion ; 3. Copper sulphate with Kamala ; 4. Copper sulphate with sodium arsenite ; 5. Ferrous sulphate with Aloes ; 6. Ferrous Sulphate with Pot. antimony Tartarate.

Of all these, copper sulphate with kamala proved to be the most effective combination. Copper sulphate is not only an anthelmintic, it has the property of passing directly to abomasum (4th stomach) and carries Kamala too with it. Therefore both these drugs in combination have the chance of acting straight upon the offending parasites. If they were first taken to the rumen, by admixture with the large amount of materials there their efficiency would have been less. Kamala not only exercises a killing action upon the worms, but being also a purgative expels

the dead and stupefied worms along with those killed by copper sulphate. Both are cheap. The experiment showed that the combination proved efficacious to the extent of 90 per cent.

The doses administered to the calves and sheep are not mentioned in the paper. The following are, however, the usual doses :

1. Copper sulphate—one per cent solution 3 to 10 ounces per dose, according to the size of the animals.
2. Kamala —½ ounce in gruel for 500 lbs. live-weight of animal.

The best way to treat would be to keep the animal fasting for 36 hours. Then commence with a dose of aloes as purgative. Afterwards use the anthelmintic, followed up again by a dose of purgative, which will be unnecessary in the case of Kamala.

Tobacco leaf powder, administered in 1 per cent infusion in 3 to 10 oz. doses is also a cheap and a reliable anthelmintic for cattle.

Other drugs such as carbon tetrachloride or oil chenopodium have a poisoning effect and should not be used. Myrobalan is a good substitute for aloes and does not create the griping of aloes. Myrobalan in 8 oz. dry pulp doses can be used in place of Aloes for purgation. Myrobalan itself is an anthelmintic. With the help of Myrobalan, Copper sulphate, Kamala and tobacco practically the whole range of worm may be safely expelled. Doses should be judiciously adjusted to the size and condition of the animal.

1405. WORMS THAT INFEST CATTLE

Worms infesting cattle and other animals and men are classified into three great classes :

(1) Cestodes or Tape worms with segmentation.

(2) Trematodes or Flat worms like liver flukes.

(3) Nematodes or Round worms some of which are so familiar.

1406. (1) CESTODES OR TAPE WORMS

Adult tape worms are generally found exclusively in the intestines. These consist of a head and a chain of segments. The head bears one or two suckers with which they attach themselves. Some have hooks in addition to the suckers. The worm consists really of two parts, (a) the head with suckers and in some cases with hooks, and (b) the posterior part, which is a proliferating area which is continually proliferating and budding off new segments. The head is called the scolex, and the whole worm with or without the head is called the strobila. A segment is called a proglottides.

The segments contain in each one of them a complete male and female reproduction organ and an ovary. In the segments nearest to the head and next to the proliferating area, these organs are not developed and are called 'immature' segments. Next to them, about the middle half of the worm, are the 'mature' segments. Next comes the 'gravid' area which contains eggs. There is, however, no sharp line

between immature and mature and gravid, one class gradually merging into another by the process of growth. These worms have head and the sex organs but no intestine.

Outside the animal body, imagine a 'head' portion only existing in a larval stage enclosed in a cystic

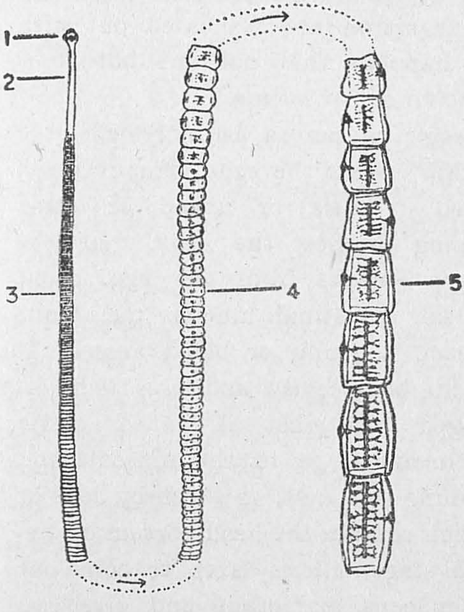


Fig. 107.
Diagram of the tape worm.

1. Head ;
2. Proliferating area ;
3. Immature segments ;
4. Mature segments ;
5. Gravid segments.

membrane and lying on the ground or on the grass. This is swallowed by an animal. On entry into the intestine the cystic case is dissolved out and the head attaches itself to the wall of the intestine and begins to suck nutrition and proliferate or bud off segments. As the length grows from off the head, what was once the first segment becomes the second and then the

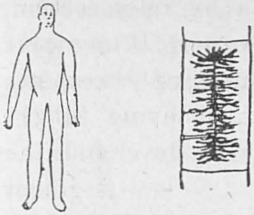
third and then the last one. In the gravid section, the reproductive organs having performed their function become atrophied, and it simply becomes a muscular wall containing the uterine sac full of eggs. At this stage the segment ruptures, and the eggs are liberated in the intestine. The segment also gets detatched from the body and drops off. The eggs and the segments are evacuated out with the fæces. It often happens that not one but 10 or 20 segments are thrown out at a time.

Generally the eggs contain a ball of cells. In many species of tape worm the eggs remain ready for being swallowed. Cattle or sheep or other animals while grazing swallow the eggs. In the intestine the embryo escapes from the egg. The embryo bores into the intestinal mucous membrane and manages to reach a lymph or blood vessel. It is then carried to the body cavity and loses its hooks and becomes changed into what is called cystic stage. It remains in that stage in the musculature. When flesh, containing this cyst, is eaten by dogs or pigs, the cysts which contain the head portion of the worm in the larval stage, allows larva to come out and bore into the mucous membrane and give rise to the adult parasite.

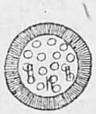
But all cases of propagaton of cestodes are not like this. Those that infect men and dogs are exactly as above. From a man's or a dog's intestine the eggs come out and are eaten with grass by, say, a cow. The eggs then develop into cyst and remain in the muscle of the cow till its death. After death the

Fig. 108.

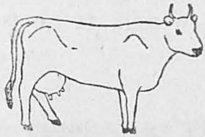
The life cycle of tape worm.



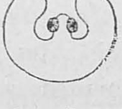
Adult worm in man.



Eggs in human faeces.



Eggs swallowed by cow.



Developes into cysticercus in the flesh of the cow.

Infected flesh of cow when eaten by man in insufficiently cooked condition allows living cysticercus bovis to becomes an adult tape-worm in man.

(After Southwell and Kirshner)

flesh with the cyst when eaten by a dog releases the larva which develops into a tape worm. If men eat the slaughtered animal's meat, contaning the cyst, cooked insufficiently, then the cyst in living stage find access into men, which will then develop into tape worm in the human intestine.

It is, however, not definitely known how cattle get infected. The above picture is of getting infection through eating cyst-containing meat by man or dog or other carnivora. In the case of cows and sheep, the eating of meat, containing cyst, does not arise. Cattle and sheep all the same get infected with some classes of tape worm such as the moniezia.

It is guessed that the eggs form fæces of animals get entrance into the intestine, and there form adult tape worm either directly or through the formation of cyst within the body of the cattle which resolves there into developed larva.

1407. CESTODES OR TAPE WORM :

(A) MONIEZIA

Moniezia belong to the *Anoplocephalidæ* family. The heads of these tape worms are provided with suckers only and no hook. The segments are more broad than long and generally contain a pair of both the genetals in each segment.

Moniezia tape worms are all large and fleshy, frequently measuring several yards in length and about three-fourth of an inch breadth.

Fig. 109.
Head of moniezia.

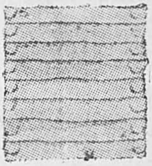


Fig. 110.
Moniezia expansa:
Mature segment.

The duration of the life of Moniezia tape worms is given variously as 70 days to 1 year.

Tape worm in cattle are not so dangerous, and much importance is not attached to them.

1408. (2) TREMATODES OR FLAT WORMS

These worms are generally leaf-like or cylindrical in shape. The adults usually have both male and female organs in the same body or they are what is called hermaphrodites. There is an intestine but no anus. The adult animals have suckers by which they adhere to their hosts. The larva of some of these complete their development in molluscs. Some go through a further development in another animal before they settle down to mature form in a vertebra. The eggs are generally operculated or have caps.

The ova are usually coloured brownish, the yellow from which on hatching a free living larva escapes into water. In some cases, as in the case of *Fasciola*, the egg contains a fertilised un-segmented ovum. A swimming larva develops later under suitable conditions.

1409. TREMATODES OR FLAT WORM

(A) FASCIOLA HEPATICA

The adult worms live in the bile ducts of the cattle and other herbivorous animals throughout the world.

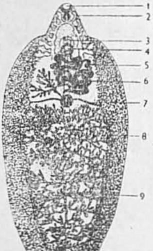


Fig. 111.
Fasciola hepatica.

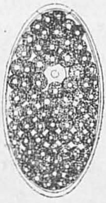


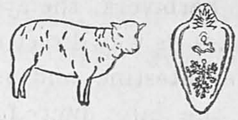
Fig. 112.
Egg of Fasciola hepatica.

Fig. 113.
Lymnœa truncatula.

They cause liver-rot, a serious disease and are responsible for great loss.

The worms are flat, brownish white in colour, and measure $1\frac{1}{4}$ inch in length and are about three-eighth inch broad. These worms, living in the bile duct, produce eggs which pass down into the intestine and are voided in the fæces. In presence of water a *miracidium* or larva hatches out in one or two months

Fig. 114. The life cycle of fasciola



Fasciola hepatica in sheep.

Egg passed off with faeces.

Miracidium escaped out of egg.

Miracidium becomes a sporocyst in snail.

Sporocyst produces numbers of rediæ in snail.

Daughter radiæ produces numbers of infective cercariae in snail.

Cercariae escape from snail and encyst on blades of grass from where they enter cattle with fodder.

(After Southwell and Kirshner)

under suitable conditions. They may remain quiescent through long periods. The *miracidium* swims about for a short time and enters a snail, passes through

several stages in it and escapes and encysts on blades of grass. When swallowed by the herbivora, the cyst wall is digested and the larva makes its way direct to the liver by passing through the intestine and its peritonial cavity. They live in the bile duct for about 9 months.

By their presence in the bile duct they cause dilatation of the duct, hypertrophy and finally fibrosis of the duct. By obstructing the flow of bile they cause *icterus* or jaundice. While passing through the peritonial wall in young animals they may cause peritonites.

The symptoms in the affected cattle are increasing weakness and emaciation, associated with constipation. The presence of eggs in the fæces, as revealed by microscopic examination, fixes the diagnosis.

There are other varietes of trematodes or fluke worms but the general processes of their life and infection are very similar. The infection can be prevented by—

(1) Not allowing the fæces to find their way to sources of water, such as canals or tanks or ponds ;

(2) By destroying the snails either by treating water with copper sulphate or otherwise. Spraying the surface of water with copper sulphate solution so that 20 lbs. of sulphate cover 1 acre is one of the processes. But this is an impossibility in practice.

If the animal survives a year after infection, the fluke naturally dies. Some flukes react favourably to treatment by intravenous injection of antimony tartarate which requires repetition from time to time.

1410. TREMATODES OR FLAT WORM
(B) SCHISTOSOMA

Nasal Granuloma or Nasal Sehistosomosis.

This disease is caused by schistosma which is a parasite of the trematode group. The sexes of these parasites are separate, and the female is usually found lying in a groove in the male. In water the ova hatch and after passing through the intermediate host, the snail, develop into cercaria or the final stage of larval development with forked tails.

Infection takes place through water in which the larvæ roam about on leaving the snail. Here they attach themselves to the skin of the animal which has come within their reach in the water. Here they cast their tails and boring their way in, enter the blood stream. From here they finally work their way into the portal vein, and develop themselves into adult parasites. It is thought that the parasites do not do great harm but it is the ova which circulating in the blood bore their way out by ,means of sharp spines and cause irritation, ulceration etc.

In the case of cattle, the ova of schistosoma nasalæ, inhabit in the veins of the nasal mucosa where they cause the formation of granulomatous masses of ulcer, discharge muco purulent matter and cause constriction of the nasal passage.

Large tumour-like masses develop at the frontal sinus and the nasal passage. They may grow to such a size that breathing is obstructed. They spread

Fig. 115. Life cycle of schistosoma.

Schistosoma in cattle.

Eggs in faeces.

Miracidium escape from egg in water.

Miracidium becomes a sporocyst in snail.

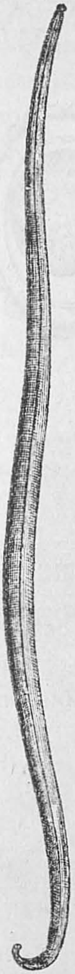
Daughter sporocysts produce infective cercariæ in snail.

Cercariæ escape from snail in water.

Cercariæ penetrate unbroken skin of cattle and becomes an adult worm in cattle.

(After Southwell and Kirshner)

backwards to the throat and also sidewise and may cause the eye ball to bulge.



Treatment : Treatment consists in intravenous injection of solution of tartar emetic or of sodium antimony tartrate which is less toxic.

A 3 per cent solution is intravenously injected 25 to 40 c.c. at a time to a course of 5 to 10 injections weekly or twice a week. The dose varies with the size of the animal.

Rectal administration of tartar emetic is also reported to have shown good results.

1411. (3) NEMATODES OR ROUND WORMS

(A) ASCARIDES

The Ascarides : The worms are like the round worms found in men and particularly in children. They infect mostly young animals. Heavy infections are observed in calves two to three months old. The ascarides are comparatively large, smooth, longated worms with a short head and smooth or dented lips. The egg contains an ovum. The ovum segments and becomes a larva in the course of a few weeks when the eggs, as voided and containing the larva, are swallowed. Calves may get infection through sucking teats soiled with ova from the fæces of the cow.

Fig. 116. Ascarides.

Emaciation, diarrhœa and constipation are created by the ascarides. They may

ball together and cause impaction. Microscopic examination of fæces reveals the characteristic ova of ascarides.

For ascarides, purgation with Myrobalan is good. Then there is the copper sulphate and kamala treatment which is also useful. Tartar emetic also does good.

Tartar emetic	...	60 grains
Water	...	4 oz.

Dissolve. Give 2 drams in milk to calves every 3 or 4 hours. Repeat till the ascarides are evacuated effectively. Follow up by myrobalan purgation.

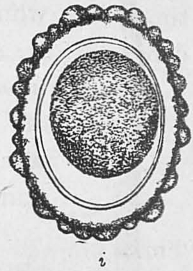


Fig. 117. Egg of ascarides.

1412. NEMATODES OR ROUND WORMS
(B) STRONGYLES OR SMALL ROUND WORMS

Strongyles are very small pin-like worms. Sometimes they are so small as to be difficultly visible, and

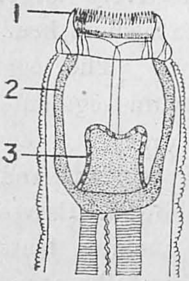


Fig. 118. Strongyles.

1. Leaf crown ;
2. Buccal capsule ;
3. Teeth.

sometimes they are much larger. They inhabit the lining of stomachs. Sometimes the lining is seething

with them. They cause indigestion, wasting and diarrhœa, also anæmia. Young animals are prone to mass infection to which they often succumb in a short time. Cattle are less susceptible to any serious danger from this infestation than sheep or goat.

1413. STRONGYLES

(a) Ancylostomes : Hook-worms

These are like the hook worms that infect men. These are about three-fourth inch long. They attach

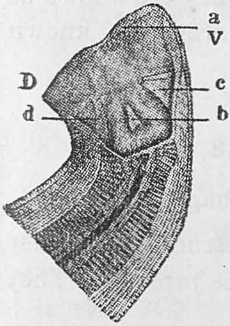


Fig. 119.
Mouth of Hook-worms enlarged.

D. Dorsal ; V. Ventral aspect ;
a. Border of mouth capsule ;
b. Dorsal conical tooth ; c. and d. Lateral pair of teeth.

Fig. 120. Ova of Hook-worms.

themselves to the duodenum by their hooks and suck blood and thereby cause anæmia. They throw out

eggs which come out with fæces which are characteristic under the microscope. Infection is through food and drinking of water containing the eggs, and some

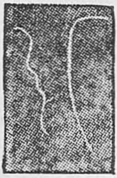


Fig. 121.
Actual size of Hook-worm.
Right. Female ; Left. Male.

say through the skin by the larva. They produce digestive disorders and anæmia. They are known as **Ancylostome**, and the particular worms are known as **Bunostomum**.

1414. STRONGYLES

(b) Nodular Worms or Œsophagostomes

These also belong to the family **strongyles.** They are about an inch long and inhabit the intestine. They do damage by massive infestation. They set up chemical and mechanical irritation of the tissues and cause the formation of worm nodules. They set up inflammation of mucous membrane. They sometimes penetrate through the walls of intestine and cause peritonitis. In the Punjab experiment for the search of a suitable anthelmintic, the calves

Fig. 122.
Ova of Nodular Worms

were artificially infected with œsophagostomes. The ova can be identified and the disease diagnosed. (1404)

1415. STRONGYLES

(c) Lung Worm

These are also small worms or **strongyles** which invade the upper air passage and cause symptoms of bronchitis or broncho-pneumonia in calves. They are long, thin, smooth, thread worms. Generally they are oviparous, their females deposit ova, containing embryos in the organs of the host. They leave the body of the host through the mucus with coughing. The coughed material is generally swallowed and then they find entrance into the intestines. After they are thrown out with fæces they change and get ensheathed. They then enter the host through ingestion and there attain maturity.

Fig. 123.
Lung Worm and its egg.

They infect swampy and marshy pasture, specially those subject to flooding. Stall infection is also possible. Sometimes for development, some variety gets into an intermediate host-like earth worm and may then get ingested with fodder containing the earth worm.

The symptoms commence with cough which gradually becomes more frequent and distressing, and is accompanied by the protrusion of the tongue on

which worms may be seen in the material expectorated. The disease develops slowly and terminates with emaciation and diarrhœa.

Older animals are resistant. Treatment is to be done with the usual anthelmintics coupled with doses of turpentine oil mixed with some other oil.

Oil turpentine }
Oil arachis } equal parts

Make an emulsion with mucilage. Give half ounce of mixed oils per dose for calves.

1416. STRONGYLES

(d) Hæmonchus contortus : Wire Worm

These small, round worms are called wire worms or stomach worms.

This worm is a blood sucker. They may cause massive infection suddenly under which the calf may succumb.

This was one of the worms with which the calves and sheep were artificially infected in the Punjab experiment referred to in Para 1404.

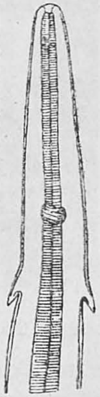


Fig. 124.
Head of Wire Worm

CHAPTER XLI

DISEASES OF THE MOUTH

1417. STOMATITIS

Catarrh in the cavity of the mouth arises from various causes such as the mastication of very rough fodder, of bearded or spiked seeds and cereals. The tongue and the mucous membranes are injured. Sometimes bits of these bodies get embedded on the tongue, on the back of the tongue and on the mucosa. There they create irritation and may, by the injury caused, allow bacteria to be lodged which create diseases like **actinomycosis (1394)**.

There are several infective diseases, the ingestion of the causative bacilli of which is harmless in the alimentary canal, but creates mischief when the bacilli get entrance into wounds. The injury to the tongue and mucous membranes of the mouth offers this opportunity.

Injury and catarrh may result from scalding by hot gruel or other feeding materials or administration of medicines in hot water or from action of corrosive chemicals in medicines. Poisons contained in certain plants also may cause catarrh. Some hairy caterpillars, when ingested with fodder, may cause inflammation of the mouth because of mechanical irritation caused by their hairs and also of the irritating substances contained in them.

Inflammation of the mouth may be the indication of some specific febrile diseases and some diseases of the digestive system and some infectious diseases such as foot-and-mouth disease, rinderpest etc.

Symptoms : In the catarrhal condition of the mouth there may be difficulty in feeding dry and hard fodder. The surface shows redness or red spots and occasionally a thick and tenacious protective mucous coat arises. The membranes of the mouth may become swelled. The tongue may get swollen and may show marks of teeth. The injuries and inflammation may lead to the formation of small ulcers.

There is increased secretion of saliva which occasionally gets decomposed giving rise to foetid odour.

Vesicular Stomatitis : It is an inflammation of the superficial mucous membrane of the mouth in which there appear vesicles or bullae, containing clear fluid.

Vesicles from the size of a lentil to that of a pea appear on the hard palate and on the inner surface of lips. They burst in a few days, leaving an eroded surface which soon becomes covered by new epithelium. Sometimes these form papules on the palate and the membranes, but vesicles do not appear. In that form the disease is known as **pseudo-aphthous stomatitis.**

Treatment : In these diseases (**Buccal catarrh and stomatitis**) the causative factors have to be found, and the causes are to be removed. Diet should be light, easily digestable and vitaminous, such as succulent green fodder, grain mash or gruel.

Any foreign bodies must be removed with the help of forceps, and where sharp dental irregularities cause the inflammation they should be smoothed down by a tooth rasp. If the teeth are defective, they should be extracted.

The mouth should be washed frequently with an antiseptic wash :

(1)	Common salt	...	1 ounce
	Water	...	4 lbs.
(2)	Thymol	...	10 grains
	Borax	...	1 dram
	Water	...	1 lb.

Where washing is difficult the solutions should be liberally applied with a swab.

In chronic catarrh, painting the eroded surface with silver nitrate one per-cent solution is effective.

1418. STOMATITIS IN SUCKLING

It is a disease of the suckling lambs, calves and goats, of infective origin in the mucous membrane which is injured in patches, covered over with at first a whitish deposit, later with grey or greyish yellow deposit. On their removal, an ulcerated surface is exposed.

Symptoms : The disease commences with salivation and swelling and redness of the mucous membrane. It is followed by the appearance of the deposit in lips and on the back of the tongue, its tip, or its sides. On the border of the lips small vesicles

appear which soon dry up and get covered with crusts. There is disinclination for sucking, lowered appetite, and later emaciation.

In strong healthy calves these generally subside after a week or so. But in weak and rundown calves, the injury continues to extend, making fresh thick deposits which give place to large ulcers. From this stage various infections may start and cause fatality to a good percentage of calves.

Healthy sucklings should be separated. The pens should be cleaned and disinfected.

Treatment : The mouth should be frequently washed with antiseptic lotion as in the case of stomatitis. In addition, the ulcerative surface should be painted with—

Borax dessicated over fire	...	1 dram
Honey	...	sufficient to make a thin paste.

The paint should be applied thrice daily. Before applying the paint on the surface, a swab of dilute tincture iodine may preferably be applied.

1419. SALIVATION

(Ptyalism)

When the mouth or throat is inflamed, salivation occurs as a secondary symptom. Use of certain drugs such as iodine, mercury and pilocarpin may cause salivation. Saliva flows in the form of foam or hangs in strings.

Treatment : The primary cause has to be ascertained and treated.

1420. PAROTITIS OR MUMPS

Parotitis rarely occurs in cattle as a primary infection as in the case of man. Generally it is due to injury to the parotic gland. It may develop as a secondary affection to actinomycosis. Cases have, however, been found where cattle suffer from an epidemic of parotitis simultaneously with the appearance of parotitis in children

Symptom : There is a swelling in the region of the parotid gland near the lower jaw. The swelling is painful and chewing has to be performed with care. In some cases the swelling may suppurate. The disease runs a mild course, and even when there is suppuration after the opening of the abscess and draining out of the pus, the disease is mitigated and healing takes place early.

Treatment : Cold compress with 1 or 2 per cent carbolic acid is recommended. Iodine ointment is useful for absorption. If there is an abscess, fomentation and surgical treatment for the opening of it is indicated. In chron ic cases intravenous injection of iodine is useful. Internally potassium iodide should be given.

1421. OBSTRUCTION OF THE OESOPHAGUS

In this disease the oesophagus is obstructed usually by impacted masses of food material and in

exceptional cases by foreign bodies. Sometimes food materials regurgitated by the rumen for rumination may get impacted, at the oesophagus.

Symptom: There is a continued effort to swallow and eructate. The animal moves its neck from side to side and stretches its neck and bends it in an attempt to swallow. It opens its mouth, protrudes its tongue and salivates profusely. Generally it refuses to take food or drink, but if any attempt is made to drink it is regurgitated.

It occasionally happens that the obstruction is at the further end of oesophagus, and the animal in its attempt to push down the obstruction swallows more stuff till the whole length of the oesophagal tube is filled with a mass of food. In case of partial obstruction only small quantities of food and water can be taken slowly but completely without regurgitation.

When some foreign body is impacted, it can be recognised by the formation of a circumscribed swelling at the place of obstruction.

Obstruction may be followed by tympanitis (**1423**), when gases evolved in the stomach cannot find their way out. An incomplete obstruction may develop into a complete obstruction when there is tympanitis, and attempt by the animal of fresh ingestion of food to swallow down for removing the obstruction.

Course: If the obstruction is due to a foreign body it may be thrown out by repeated eructations or passed down into the stomach by swallowing. The animal then feels easy. If the objects are small and

smooth, the chances of their being expelled out or swallowed are very great. But if it is too big or tightly fixed for removal either way, and if the occlusion is complete, then the animal dies of the effects of tympanitis, the diaphragm pressing upon the heart and lungs and causing asphyxia or stopping circulation. Death occurs in a few hours. Some times the trachea may be so compressed locally as to asphyxiate.

When death does not come so early as within several hours of obstruction, the necrosis of the oesophagus commences, leading to suppuration, perforation and ultimately to death.

When the obstruction is by a bolus of food, it may, in course of time, be softened by saliva and may squeeze and move up or down without requiring surgical interference. But if it is hard and dry, soaking may cause dilatation or perforation with fatal consequence. Small, sharp bodies may perforate and enter the surrounding soft parts and may be encased and may afterwards cease to create trouble.

Treatment : When the obstruction takes place near the entrance it may be taken out by hand. The mouth of the animal is kept opened and the tongue kept drawn out. A long handled forcep with dented edge or a ring-ended facet to grip a round object may be used if possible. A hooked wire may be introduced and passed on to the other side of the object which may then be pulled out. Devices have to be made suitable to the object and its position for pulling it out. A loop of rope even may be used in the

same way in which a cork pushed inside a bottle is pulled out. The place may be lubricated with oil or better with mucilage.

As a final measure injection may be given for inducing forced vomiting. For this purpose strychnine may be injected near the locality which may induce strong muscular contraction accompanied by vomiting, resulting in expulsion of the obstructing body.

When tympanitis is developing, in order to get time for trying methods of removing the obstruction, the rumen may be punctured with a trocar as described under tympanitis (**1423**). It may happen that the removal of the pressure of tympanitis itself may help the disappearance of the obstruction.

CHAPTER XLII

DISEASES OF THE STOMACH AND INTESTINES

1422. VOMITING (EMESIS)

Vomiting is an act of evacuation of the contents of the stomach through the mouth or nose. It is due to a direct or indirect stimulation of the reflex centre of vomiting.

Vomiting in cattle is caused by irritation of the stomach caused by the food-stuff or by the action of caustic drugs or emetics, by parasitic worms in the stomach or by irritations due to gastric ulcer.

While cats and dogs vomit with the utmost ease with the head extended and lowered, cattle have to make great efforts to vomit. Vomiting is usually preceded by some premonitory symptoms, such as nausea, restlessness, empty swallowing, eructation etc. Cattle lie down and stand up restlessly, tremble, breathe deeply or groan in course of which, through effort, the fluid or pulpy contents of the rumen are evacuated through the mouth accompanied by the contraction of the muscles of the abdomen.

Treatment: Vomiting often relieves the rumen of its undesirable contents and is, therefore, to be welcomed and should be assisted. When there is

excessive vomiting and needs stopping, the following may be used :

(1) Camphor $1\frac{1}{2}$ dram in gruel.

(2) Chloral Hydrate 1 ounce in gruel.

1423. TYMPANITES

Acute flatulence or Meteorism.

Acute flatulence is caused by the quick distension of the rumen and reticulum on account of the formation of gas.

Causes : Most generally it is caused by the ingestion of easily fermentable green fodder, particularly leguminous fodder. Fodder plants, wet with dew or with rain, may become harmful, and, therefore, tympanitis is more frequent after the animals are in pasture in the morning. Drinking of water after feeding on wet leguminous or succulent pasture contributes also to precipitate an attack. Green fodder which has become withered or heated may also cause flatulence. There are some animals that have a predisposition for it. Besides, large ingestion of easily fermentible fodder, and any factor which induces the obstruction of the œsophagus generally causes tympanites.

A very frequent and fruitful cause of tympanites is the feeding of cooked rice or *dal* or *chapatis*. These may be usefully fed to cows in regulated quantities. But when a quantity is given on the top of fodder without mixing with it, the ingestion at a time of quantities of starchy food or cooked pulses induces

tympanites. After feasts in homes the surplus cooked materials given over to cows may cause serious accidents. It often happens that a hungry animal gets access to cooked cereals and gorges itself on it with fatal consequence. The stock-owner has to be careful to prevent these accidents from happening.

On account of the rapid formation of gas, the rumen and the reticulum become distended and the symptoms are the same as in the case of impaction of rumen.

When gases accumulate, the distension takes place and the greater the accumulation of gas the greater the pressure. The wall of the rumen may become so tense that it can with difficulty be pressed down.

Symptoms: The animal stands motionless, arches its back and looks to the abdomen by turning its head. The left flank becomes level with the dorsal vertebral column and may rise above it. Eructation and vomiting may occur.

There is dyspnœa, cyanosis, feeble pulse, and coldness of the extremities and ears. There is an expression of anxiety, and if the pressure is not relieved the animal falls down and dies in convulsions.

Distention may occur even when the animal is in the pasture or immediately afterwards. It may be found dead. With increasing distention, after it is noticed, the animal may die in a few minutes. In other cases, gas forms at a slower rate and the animal may get relief by belching or vomiting, after which it recovers.

Treatment: In very acute forms when the tension is very high and the animal is in great distress, when there is difficulty in breathing, the case should be treated as an emergent one and the rumen should be punctured to let out the gas and save the animal.

Puncture of rumen: Draw a line from the external angle of the ilium to the middle of the last rib on the left flank. Select a point at the middle of this line, which will be about 2 inches away from the rib. Point the trocar to the right elbow. After puncture draw out the trocar and let the canula remain. Gas and some ingesta will come out. Keep the canula in position for an hour or so, keep it tied so that it may not slip out.

Where a trocar canula is not available, make a puncture with a sharp knife and make it so big that a bamboo tube may be pushed in. This tube may be of half inch or more outside diameter. Have a notch cut at the outer end and tie a string to the notch and fix it with the body in such a way that the tube may not slip in and get lost. Dip the string and the tube in iodine solution before use. Antiseptic precautions should be carefully taken. If nothing is at hand, take what antiseptic measure is possible by scalding a knife and then plunge it. The operation is a very simple one. The wound heals of itself after the withdrawal of the canula or tube. When the cut is large, say, over an inch, it may be necessary to stitch the ends of the skin and bandage the wound.

In milder cases, put the animal in a sloping position, the front feet resting on a higher level than

the hind legs. Digging the earth a little to accommodate the hind legs, about a foot or a foot and a half below the ground level, while the front feet are on the ground, will do. In this posture the œsophagus opening gets more chance to let off the gas. After keeping the animal in this position, begin massaging with heavy pressure on the abdomen and flanks. Two men should perform this from either side. Small animals like calves can be held in an inclined position more easily. Massage upwards and downwards may continue for 5 to 10 minutes and again after intervals of sometime. In pregnant cows the right side should not be pressed and massaged. Strong friction with pads of straw may be used. Massaging includes here kneading, boring and pressing down movements. This operation should be aided by exciting belching or vomiting artificially by irritating the soft palate and the fauces with a soft, blunt, thrashed-ended twig, just as feathers are used for inducing vomiting in men or as the fingers are introduced to touch the fauces.

Oral administration of drugs is of little use.

After the distention has subsided, the animal should be put on very restricted ration for sometime.

For meeting an emergency, stock-owners should do well to keep a range of trocar canulas.

1424. FOREIGN BODIES IN THE STOMACH

Foreign bodies find their way into the rumen and the reticulum owing to the habit of some cows of possessing a perverted hunger of eating anything that

they may come across. Some of these bodies, after entry into the rumen, get lodged there and if the ends are blunt cease to create mischief. Even with sharp-pointed heavy objects, such as knife blades, the points after entry into mucous membrane may create a wound which may heal and keep the object bound to the place by cicatrix. Others may pass on to the reticulum and cause mischief there. Some objects like hat pins may create fatal injury by sticking through the diaphragm and injuring a lung or the heart. Pneumonia or cardiac or valvular disturbances follow, ending in death.

Some light objects may pass on to the stomach and cause obstruction to either the entrance end or the exit end of the stomach. Some calves are in the habit of licking. Cows also do that. The dislodged hairs pass on as pellets and in the stomach begin to accumulate and form balls.

These foreign bodies may interfere with the working of one or several of the stomachs and cause indigestion and also impaction. Sands may deposit in the rumen and create dyspepsia. Sharp-pointed articles may travel on and pass out through the skin by causing a local inflammation and suppuration or they may get lodged securely somewhere and cease to create harm. But when they begin to cause mischief it is difficult to treat the cases. Surgical interference becomes necessary. Except in the case of specially prized animals, the chances of obtaining veterinary surgical aid for a major operation is generally out of the question.

Prevention of access by cattle to these objects should be attempted. The licking off of hair should be prevented.

1425. GASTRIC AND INTESTINAL CATARRH

Catarrhs occur in the fore stomach, or the fourth stomach, commonly on account of errors of diet. Unsuitable food, too hot food, may also cause gastric catarrh.

Symptoms : Appetite is diminished. The animal sometimes exhibits a tendency to lick various substances, e.g., litter or nauseating matter or indigestible substances. There may be different degrees of stupor. The animal appears to be very feeble and stands as in pain with the back arched. Rumination is infrequent or irregular. Sometimes offensive gases are belched out. The left flank becomes tense. There may be tenderness in the region of the abomasum. There is generally some constipation.

Treatment : The treatment should be dietetic. For the first two days no food should be given and only water to drink. After that suitable fresh, green fodder in small quantities should be offered, with a little salt and oil cake.

The stomach contents may be evacuated in persistent cases with a dose of magnesium sulphate, say, one pound in two doses for grown up animals. Acid fruits generally improve condition, such as tamarind or lemon.

Intestinal catarrh ultimately leads to diarrhœa with foul-smelling fæces. In such cases evacuation of the

stomach with the help of purgative such as castor oil in emulsion form (one to two pounds of oil in two doses) is suggested. Disinfection with daily doses of Thymol in ½ dram doses is good.

After evacuation powdered wood charcoal in 8 oz. dose, suspended in water, is useful for cleansing the intestine. Kaoline also may be similarly given for the same purpose. For persistent disease, purgatives alternated with lavage of stomach is indicated. Rectal irrigation with tepid water is also useful in some cases.

When the disease persists in spite of lavage, purgation by castor oil, disinfection by thymol and cleansing by charcoal or kaoline, it may be necessary to use astringents such as one dram dose of powder opium in chalk. Catechu or powder arjun bark may be given with Bismuth Carbonate and with demulcents such as linseed mucilage.

Lime water is useful for calves. (**1403**)

1426. INTESTINAL COLIC

This disease is related to acute intestinal catarrh. The appearance of colic is sudden and it becomes sometimes severe. After a time diarrhœa sets in and then the animal recovers. There is intestinal contraction in colic which may be relieved by application of warm compress to the abdomen; warm pack may be given in the form of sacks soaked in warm water, covered with a warm dry blanket. This is to be renewed every 10 minutes. In severe pain morphine is to be injected subcutaneously in 2½ to 4 grain doses.

Occasionally the administration of 1 ounce turpentine mixed with a equal measure of bland vegetable oil followed by an aperient like magnesium sulphate (1 lb.) does good.

1427. CHRONIC INTESTINAL CATARRH

Chronic catarrh is characterised by depression and gradual emaciation. Constipation alternates with diarrhoea in which fæces may be mixed with mucus pus and sometimes blood.

For treatment the same course is indicated as in the case of acute intestinal catarrh, such as the use of purgatives, astringents and demulcents. In these cases disturbance is sometimes due to the presence of intestinal worms. The parasties have to be cleared off. For which see Diseases caused by worm parasites in chapter 40.

CHAPTER XLIII

DISEASES OF THE LIVER

1428. JAUNDICE : ICTERUS

Jaundice is a symptom of a number of diseases in which the bile pigment accumulates in the blood and is partly deposited in tissues and partly excreted through urine.

Jaundice exhibits itself in the yellow discolouration of the visible mucous membranes of the body. The eye, nose, mouth, all show yellow discolouration as also the unpigmented portions of the skin.

Bile is produced by liver and poured through the bile duct into the intestines. This flow may be mechanically arrested causing formed bile to pass directly to the blood and create mischief. Or, it may be caused by the functional disturbance of the liver in which case bile formed in the liver cells, fails to find its way into the bile ducts. Of the mechanical causes of the obstruction to the flow of bile into the intestine, some are the formation of bile stones or gall stones, which block the passage, or the swelling of the lining of the mucous membrane of the duct. Liver flukes may cause obstruction ; round worms in the bile duct may choke the passage ; cysts or tumours at the opening of the bile duct may interfere with normal flow ; lumps of hard fæces in the intestines may act as impediment to the flow. The organ liver

may fail to function properly on account of cirrhosis, necrosis and various other degenerations. Digestive disturbances and diseases like piroplasmosis may affect the liver and cause bile to be absorbed by the glands, rather than allow it to discharge its function by draining into the bile ducts.

Jaundice may appear as an acute or chronic condition. In the acute stage there is a sudden discolouration of the membranes brought about. The temperature rises, the animal becomes dull and depressed, weakness becomes marked, foul smell comes from the mouth. The condition needs emergent action, otherwise it may turn fatal.

Jaundice, however, generally develops slowly as a chronic condition. The yellow tinge gradually appears on the membranes. The first to be observed is the yellow of the conjunctiva. The tip of the tongue, particularly the dorsum of the tongue, becomes yellow or reddish yellow, specially observable on slight pressure. The fæces become clay coloured. Bile gives the normal character to the fæces and in its absence, the colour of stool takes the colour of clay. Digestion is seriously affected. Bile not only helps digestion but works as an antitoxic agent preventing putrefactive changes in the intestines. In the absence of bile, toxins develop and produce lethargy, disinclination to move, spasms, excitability and dyspnœa. Constipation very often supervenes.

When the chronic stage advances, dropsy is developed in the abdomen, the patient sinks, poisoning effects reach the nervous system and death follows.

Treatment : The cause should be found out and removed, if practicable. If parasites had caused it, they may be expelled by anthelmintics and purgation. When tumours cause the troubles, then surgical operation is necessary and the case becomes hopeless. Obstructing materials in the intestines may be readily removed. When the functioning of liver cells are involved, drugs stimulating liver to action may be of use, such as calomel, sulphate of soda or magnesium. The diet has to be regulated. Proteins and fats impose greater work upon the liver and foods, rich in them, should be avoided. Aloes is a cholagogue ; it may be given. Much dependence may be placed upon the regular use of magnesium sulphate in doses of 8 oz. or more daily for adult cattle and on calomel in fractional doses of 4 grains, 6 or 8 times daily combined with mag. sulph once a day.

1429. GALL STONES

Characteristic gall stones are rare. Some clumpy deposits or incrustations only usually form in the bile duct of the cattle. The formation of gall stones is often due to the inflammation of the biliary passage caused by the extension of bacterial infection from the intestines or by parasites like liver flukes or from foreign bodies in the bile duct. Infective diseases in general may infect the bile duct.

Stones are found more often in the gall bladder than in the duct.

Symptoms : Gall stones may be present in large numbers in the gall bladder without causing any

inconvenience or digestive disturbance. Only when a stone travels down and closes the bile duct, causing spasmodic contraction of the muscles, that colic from mild to severe type appears. Stoppage of the duct may, in addition, cause jaundice. Liver sometimes becomes enlarged and sensitive.

Treatment : The muscles of the duct have to be relaxed. For this purpose narcotics should be given. Morphine subcutaneously may be injected in adult cattle in 2½ to 4 grain dose.

The passage of stone may be helped by mild aperient, such as castor oil. When the disease recurs, continual use of magnesium sulphate is recommended.

CHAPTER XLIV

DISEASES OF THE PERITONEUM

1430. ASCITES

Dropsy is the accumulation of watery fluid in one or more parts of the cavities of the body. When the accumulation of watery fluid is below the skin it is called **oedema**; if it is widespread it is called **anasarca**; and dropsy affecting the abdominal cavity is called **ascites.**

Ascites is a symptom of the one or several diseased conditions. In **ascites an** excessive amount of fluid collects in the cavity which causes a fluctuating swelling and entail disturbance of digestion, nutrition and action of the heart, and also of respiration. The stagnation of the fluid may be caused by faulty action of the heart, or rarely through some local obstruction of the free flow of blood. It may arise when an animal is heavily infested with worms or suffers seriously from **occidiosis** or tuberculosis.

Ascites developes slowly and as the fluid accumulates the abdominal wall enlarges to accomodate it. The abdomen becomes slowly more and more pendulous. It may appear in the case of a cow that it has become pregnant. But soon the fluctuation of the fluid on pressure leaves no doubt as to the character of the swelling. If one side is given a sharp tapping it travels to the opposite side. When the

accumulated fluid presses the diaphragm, breathing may become laboured. The animal begins to lose condition, the spine comes out prominently.

Percussion reveals dullness, the area of dullness varies with the position in which the animal is placed, standing or sitting. In intermittent palpation a splashing sound may be heard.

In ascites the location of the centre of the disturbances is helpful in treatment. If it is due to the failure of the liver to work, jaundice will accompany ascites and the liver will show enlargement on percussion and palpation. If it is due to disease of the heart, the heart sound may reveal cardiac murmurs. There will be diminution of urine, and cyanosis may be present in this case.

Treatment : In young animals rapid improvement may follow on the partial removal of the fluid by tapping with a trocar and inserting a canula, till the distention comes to the desired level. Too much fluid should not be taken off at a time. Asceptic precautions should be taken on introducing the trocar canula.

The animal may be operated lying down. After the withdrawal of the canula, the animal should be turned so that the abdomen looks up and a stitch or two should be put to ensure cessation of the flow of fluid. It should be followed by a pressure bandage. It is advisable to shave the site and paint it with tincture of iodine before the sterile trocar and canula are introduced.

In less severe cases, improvement occurs by stopping salt in the ration and on dry feeding.

Punarnava, (9 oz. dry or $2\frac{1}{2}$ lb. green) is recommended as diuretic. **Magnesium sulphate** should be repeatedly and systematically given and fæces kept semi solid. Chloride of calcium in 2 to 4 dram dose has been found to be useful.

When the accumulation of fluid is larger several punctures at intervals of say, one or two weeks are necessary; withdrawing a fraction of the accumulation every time.

1431. PERITONITIS

Peritonitis or inflammation of the peritoneum which is the lining membrane of the abdominal and pelvic cavities. Inflammation may be acute or chronic. It is generally due to infection by one or other of the various micro-organisms that either inhabit or find their way into the intestines. From there they may penetrate the intestines and reach the peritoneum and cause inflammation. Bacteria like pasteurella, streptococci, staphylococci, coli bacilli, bacillus tuberculosis, B. pyogens may all be involved.

Peritonitis may also be caused by injuries to the abdomen or wounds in it such as by goring by cattle or boar. Foreign bodies in the stomach may cause rupture of the peritoneum. Septic substances emerging from the uterus may cause mischief. Wounds in the stomach, intestines; bladder may cause peritonitis. If any of the abdominal organs become infected with bacteria and suppurate, such as the suppuration of liver, spleen, prostate, testicles, then also peritonitis may develop. Defective castration

can, therefore, lead to it, if there is suppuration after the operation. Diseases like hæmorrhagic septicæmia which cause a generel infection may cause peritonitis.

When the neighbour organs to the peritoneum get repeatedly attacked with subacute inflammation they may give rise to local adhesions and may cause localised chronic peritonitis. Exposure to cold, debilitating influence, violent blows on the abdomen may be secondary causes of peritonitis.

Symptoms : In acute general peritonitis, pain in the abdomen is the most general symptom. The peritoneum has got great anti-toxic and bacteriolytic power. When in spite of this the peritoneum gets affected, the injury becomes serious. The animal naturally shows evidence of pain by moaning, bellowing, grinding its teeth and looking round and switching its tail. The animal avoids sudden movements and stands stiff with arched back, and the head and neck are drawn backwards.

In large animals a rectal examination may reveal the condition of the peritoneum, and if rupture has taken place it can be determined from the presence of food particles.

There is generally lachrymation with purulent discharge from the eyes and there is watery and mucoid discharge from the nose.

Perforative peritonitis : It is manifested by sudden prostration, coldness of extremities and feebleness of pulse to almost imperceptibility. There is profuse sweating and tenseness of the abdominal wall. There is a rise of temperature.

Chronic peritonitis: This disease is manifested by periodical rise of temperature, digestive disturbance and diarrhœa. In draft oxen it has often an insidious onset, beginning with slight rise of temperature. The circumference of the abdomen is greatly enlarged and the animal loses condition and shows tenderness in the abdomen. The condition may last for weeks and months. After further aggravation, temperature falls aud the animal dies in a few days.

Acute peritonitis: It may develop so quickly as to cause death in course of the day, specially after puerperal infection when a clinical picture of septic intoxication appears. But generally the symptoms develop slowly and terminates fatally in 4 to 14 days.

Acute peritonitis is a dangerous disease, specially in the case of gastric or intestinal perforation. In chronic cases or local adhesions giving rise to the disease, the prognosis is more favourable, specially in the cases following external injuries.

Peritonitis from external injuries to the abdomen should be prevented from spreading by antiseptic treatment of the wound. But cases due to internal suppuration are mostly hopeless and cannot be saved without timely surgical interference.

To diminish the absorptive power of peritoneum intra-peritonial injection of camphor (1 oz. in oil) is recommended. For diminishing pain cold compress may be found useful. Opium is indicated for checking intestinal movement, in doses of 1 dram for adult cows.

If there is constipation it should be treated with castor oil. If there is accumulation of fluid, puncture may be necessary under aseptic conditions. In chronic peritonitis absorption is helped by brisk friction, by cold compress and by the internal administration of potash iodide in 1 to 2 dram daily doses.

CHAPTER XLV

DISEASES OF THE NOSE

1432. NASAL CATARRH : CORYZA

Catarrh in an acute form is generally caused by exposure to cold or to cold and damp weather, and also by sudden changes of atmospheric conditions. Sometimes inhalation of dust and smoke may cause coryza.

Chronic catarrh does not usually develop from acute catarrh. Chronic catarrh is generally secondary to complications affecting the neighbouring organs, such as laryngeal, pharyngeal, or bronchial catarrh, pulmonary tuberculosis or lung-worm disease.

In acute catarrh, a thin watery viscid discharge appears from the nares which becomes more profuse later on. Eventually the discharge becomes thick and then ceases. The mucous membrane becomes red and swollen. A common complication is the setting up of conjunctivitis with redness and swelling of the mucous membrane. In chronic catarrh the discharge appears and stops, and then suddenly reappears in greater quantity, specially on lowering the head.

The mucous membrane becomes swollen and ulcers and cicatrices may appear. Chronic nasal catarrh of long duration has a tendency to extend to adjacent organs. Sometimes catarrh appears in a benign

infectious form in the cattle. There is then a loss of appetite, lassitude and a rise of temperature. The animal recovers in 2 or 3 days.

Treatment : In acute or chronic nasal catarrh the nasal cavity may be washed with an astringent and disinfecting lotion.

For lotion, alum, boric acid or borax, one per cent in water may be used. A little thymol, 5 grains per pound of lotion, adds to its efficiency. A nasal spray of one per cent thymol in arachis oil may be given with benefit, particularly in chronic cases.

1433. CROUPOUS RHINITIS

Croupous rhinitis is intense catarrh of the nasal mucous membrane with extensive formation of pseudo-membranes. The cause mostly is bacterial infection. It appears as a secondary complication to cattle plague, or rinderpest, and malignant catarrhal fever.

Symptoms : Symptoms are the same as those of acute nasal catarrh but more severe, and there is a formation of thick grey or yellowish deposit of pseudo-membranes on the swollen mucous membranes. The nasal discharge is thick yellow and sticky and contains shreds of the pseudo-membranes.

Treatment : It is the same as in the case of nasal catarrh. The pseudo-membranes, however, dissolve easily on irrigation with 1 or 2 per cent lotion of bicarbonate of soda.

CHAPTER XLVI

DISEASES OF THE LARYNX, BRONCHUS AND LUNGS

1434. LARYNGEAL CATARRH : LARYNGITIS : ANGINA

Laryngitis often results from exposure to cold or from exposure to dust. Long-continued coughing also may induce it. Mechanical injury to the larynx may also bring about laryngitis. It may be a secondary condition in coryza, or pharyngitis, bronchitis, or pneumonia due to the extension of the inflammation from either end or due to the irritant action of the secretions of those diseases. Those animals which have less power of resistance are more susceptible.

In acute attacks the folds on the lining membrane and the vocal cords are intensely affected and become red and swollen. Mucus accumulates, and sometimes the vocal organ is studded with small red spots. There may be superficial ulceration. In chronic cases the mucous membrane is swollen and granulations appear on the surface.

Symptom : There is a constant cough, short and dry which after a time becomes more moist and more prolonged. Slight irritations are responded to by paroxysms of cough. Occasionally there is nasal

discharge and the lymph glands also get swollen. Coughing is often due to an effort on the part of the animal to avoid pressure on the larynx. When there is swelling or œdema, there is interference with and difficulty of respiration. There is only a slight rise of temperature, which may be high when the disease is a companion to some other infective disease. In chronic cases, the symptoms are the same, only they are less painful. Sometimes the coughing is accompanied by an explosive sound.

Treatment : The animal should be given rest, a light diet, and should be kept in a dust-free atmosphere, and if possible, in the open. If the cough is very frequent, inhalations may do good. Thymol lotion (5 grains to a pound) may be sprayed with an atomiser into the opened throat. Antiseptic and other washes, as in nasal catarrh, may be given. In chronic laryngitis, a soothing effect is obtained by painting the larynx with one per cent solution of silver nitrate. Painting with thymol in oil of 2 per cent strength is also recommended.

In croupous laryngitis, the larynx is covered with the formation of fibrinous pseudo-membraneous deposit on the larynx, trachea and on the pharynx. The symptoms are the same as in laryngitis, but it is more generally accompanied with dyspnœa, and whistling or rattling sounds. After 4 or 5 days the fibrinous deposits are thrown off by coughing and there is an improvement. Treatment is the same as in the case of laryngitis. When the pseudo-membranes do not come out easily, their expulsion by the administration

of emetics, such as copper sulphate 2 to 7 grains in 2 ounces of water or tartar emetic 2 to 4 grains in a similar solution is recommended. Application of hot fomentation is calculated to give relief.

1435. BRONCHITIS : BRONCHIAL CATARRH

It is an inflammation extending to the various depths of the bronchial tube. In acute cases it is limited to the larger bronchial tubes while in chronic cases the smaller tubes are more generally affected or it may involve the whole of the bronchial tree.

Inflammation starting at the nose may travel down to the larynx and pharynx and then pass on to the bronchial tubes causing bronchitis. Or the inflammation may directly seize the bronchial tubes due to exposure, to inhalation of dust or other irritants, or it may be due to some specific infective diseases like pox, foot-and-mouth disease, or malignant catarrhal fever. Chronic bronchitis develops generally as a secondary to long-continued respiratory disturbance or disturbance of circulation in the lungs. Parasitic infestation of the lungs by lung worm may also lead to bronchitis. Chronic pneumonia or chronic lung or heart trouble may lead to chronic bronchitis.

Very young animals and old debilitated animals are specially susceptible to the disease.

In acute catarrh of the larger bronchi there is a short, dry and painful cough which gradually becomes looser with an increase in secretions. When the secretions are thick and tenacious, rales are heard and they are sharp and crepitant. When the secretions

become fluid the sound becomes dull ; when the larger vessels are affected the sound is coarse and dull, but when the smaller once are affected the sound is high pitched. Fainter sounds come from deeper affected parts. Sometimes the louder sounds may be heard without auscultation by simply standing near the animal. Nasal discharge is present in most cases. The temperature at the onset of attack rises to 104°F but goes down in acute cases on the second or the third day. In chronic cases, the larger bronchi get affected first and then the smaller ones. There is occasionally difficulty of respiration which is accelerated.

The primary catarrh is a benign disease. But when the smaller tubes are affected and there is rise of temperature and severe dyspnœa the prognosis is not favourable.

Treatment : It follows the lines indicated for laryngitis. The animal should be given rest and kept in a well-ventilated house. The diet should be easily digestible and free from dust. Sufficient water should be given. The bowels should be kept moved.

Tenacious and thick secretion should be attempted to be softened by the administration of demulcents and expectorants and antispasmodics.

Vasaka is very good for both acute and chronic bronchitis. The powdered leaves may be made into electuary with molasses and put under the tongue or on the teeth.

2 ounces of dry vasaka leaf powder per dose is to be given three times a day. Ammon chloride 2 to 4

drams per dose and potash iodide 1 to 2 drams per dose may be given for thinning down the tenacious secretions and mucus.

In case of severe dyspnœa, due to excessive secretion and coughing, emetics are useful as indicated for laryngeal catarrh.

Inhalation of antiseptics may give relief. Moist and warm fomentations to the chest are beneficial in all cases, when there is no severe dyspnœa. Camphor may be given as a stimulant in one dram doses as electuary.

1436. INFECTIOUS BRONCHITIS : CATTLE INFLUENZA OR CATTLE DISTEMPER

Influenza in the cattle may follow influenza in man, more specially influenza in horses. Occasionally secondary infections are caused by streptococci, pasturella, and pyogenic bacilli, Some consider these secondary organisms to be the primary cause of the disease. Natural infection takes place through ingestion of contaminated food and drink, also through expirated droplets.

The disease appears after an incubation period of 2 to 10 days. Temperature rises from 104 to 106°F. There is reduced appetite and reduced milk secretion. There is at first watery and then purulent discharge from the nose. The eyes become affected. There may be purulent conjunctivitis, profuse lachrymation and swelling of the eyelids. There is salivation, stretching of head, and difficulty of breathing and distressing coughing. Signs of bronchitis such as

vesicular rales and ronchii are heard. The pulse rate is raised from 70 to 80, or even 100 per minute. The animal loses strength. Sometimes diarrhœa appears. In simple cases recovery occurs in 8 to 14 days, while in severe cases it may take 3 to 4 weeks, and even after that the cough may continue.

Treatment : The same lines should be adopted as in the case of bronchitis. In severe cough, morphine injection may be given in $\frac{1}{4}$ grain to 2 grain doses. Nursing is of more importance than medication. Subcutaneous injection of 40 to 60 c. c. of boiled and sterilised milk is said to give favourable result. The milk should be boiled for 10 to 15 minutes and strained through cloth.

The animal should be kept warm and comfortable and in plenty of circulating air. In case of constipation the bowels should be moved by an aperient.

1437. PNEUMONIA

Pneumonia is inflammation of the lung substance. There are various forms in which lungs are affected in pneumonia, and there are many names. Only a few are given here.

Croupous or lobar pneumonia : In this disease the lungs become congested or engorged and the blood vessels become greatly distended. After the congestion period, which is of short duration, is over, the lungs uudergo red hepatisation or it becomes like a piece of liver tissue losing the character of lungs. In this stage the air sacs of the lungs get filled with blood plasma and render the action of refining

the air in the affected portion ineffectual. The smallest bronchioles are also often filled with the same fluid. The exudate has the character of a solid fibrin, and from this the name 'croupous' is given. After about 2 days the character of the blocked portions of the lungs change and they become grey from red. The consistency of the consolidated material becomes a little softer but the affected portions remain still liver-like. At this stage the white blood corpuscles enter and attempt to clear away the blocking in the lung cells. From this stage, after a time 'resolution' sets in. The coagulated exudate becomes gradually liquefied and gets absorbed. With the progress of absorption, the lung tissues begin to perform their usual function, or the stage of cure sets in. In bad cases, instead of absorption the liquefied material suppurates and abscess or gangrene may result.

Croupous pneumonia may affect the lungs in localised patches and may affect one or both the lungs wholly. When there is consolidation, the lung does not function, and the more extensive is the affected area the greater are the distress and seriousness.

In outbreaks some specific organism may be responsible, but generally the bacteria that are usually present and remain quiescent, get the upper hand, in case of weakness or on exposure to cold or for some other infections.

In the beginning there is only a rise of temperature. Gradually breathing becomes more and more difficult and may take the character of panting, the breath

being taken in jerks. The neck is stretched out, the nostrils are dilated and the sides of the chest may be seen lifting. Coughing is there, but not so marked, neither so distressful as in bronchitis. There is some nasal discharge, When gangrene of the lungs takes place, the discharges become rusty or reddish in colour. With the progress of gangrene the discharges have a putrid and offensive odour. In pneumonia cattle like to lie on the affected side because the pressure gives some relief. In pneumonia in man there is a period of crisis which is well defined, but in the cattle there is no sharp change. From the 5th to the 8th day, marked change for the better can be observed in favourable cases. The breathing improves. Appetite slowly returns and there is a general improvement in the appearance. The discharge from the nose becomes copious and fluid. The pulse gets better. These continue to be better from 7 to 10 days. In bad cases, the discharge becomes foul-smelling and there is no improvement in appetite, and temperature falls to normal or goes below it.

At the commencement of the disease the percussion note after 3 or 4 days begins to be dull, and in another 2 to 3 days the notes change to complete dullness. The change in resonance is observable behind the elbow to the middle or upper third of the thorax. The dullness continues unchanged for 3 to 5 days. After this period the dullness resolves, and the sound becomes tympanic, changing to normal resonance. The respiratory changes also correspond to the stages of the disease. At first, there are

vesicular crepitations, and this is soon followed by bronchial breathing. They pass away during hepatisation, but soon reappear with the commencement of resolution.

Diagnosis : The sudden appearance of high fever which continues for several days and then its subsidence by degrees, the changes on percussion and auscultation, the nasal discharges and the usual termination in recovery in about 2 weeks are characteristics of the disease. It may be distinguished from broncho-pneumonia in which there is a general presence of bronchial catarrh and in which the development of the disease is slower. Contagious pleuro-pneumonia of cattle has to be differentiated from this disease, the course of which runs for several weeks.

Treatment : The animal should be given rest and kept under the best possible hygienic conditions. There should be ample ventilation day and night with protection from rain and cold. Frictional massage is beneficial. Food should be given in small quantities, such as some green fodder or tuberous plants. Medicinal treatment in a case running a typical course is unnecessary. In case of temperature rising very high, cold water sponging, cold sprays or rectal infusion of cold water has to be applied. The temperature has to be kept down. Pneumonary gangrene may be benefited by inhalation of 2 or 3 per cent of carbolic lotion 50 c.c. at a time through an atomiser. Care should be taken not to 'drench' the animal suffering from pneumonia.

Sulphapyridine or M. B. 693 is doing wonderful work in case of pneumonia of man. It is expected to work with equal efficiency in animals also. Wherever possible it should be administered. It can be given as an injection in a soluble form and this is better. Use of counter-irritants as embrocation is recommended.

1438. CATARRHAL PNEUMONIA OR BRONCHO-PNEUMONIA

Catarrhal pneumonia differs from croupous pneumonia in several particulars. In this disease the inflammation is more diffusely scattered throughout the lungs. A few lobules are attacked here and there instead of being localised in one or more large lobes as in lobar or croupous pneumonia. At first the affected patches are dense with bluish red appearance, tending to become yellow. In these there is no fibrinous deposit as in the croupous form. The dense accumulation in the lung cells disappear in cases of recovery through fatty degeneration, liquefaction and final absorption. In unfavourable cases they may undergo degenerative changes and abscesses may form, or the affected areas may become almost solid with a caseous material. In man from such a stage tuberculosis may begin with tubercle infection spots already present in the lungs, and the same change may come over in the cattle also. Broncho-pneumonia occasionally succeeds an attack of bronchitis which may have been almost insignificant at first. In other cases, broncho-pneumonia accompanies bronchitis.

When this happens, the inflammatory processes travel from the bronchioles to the air alveoli, or portion of the lung may have its bronchial tubes blocked with catarrhal deposits making that portion of the lungs unable to function, and then the inflammation travels there. Broncho-pneumonia may complicate existing lung troubles from tuberculosis or from attacks of influenza.

Infection from various bacteria, inhalation of irritating materials or direct injury to the lung substance by penetrating bodies may cause broncho-pneumonia. Cold, chill or debility may be the predisposing causes. In fact, when the resisting power of the lung tissues is reduced the disease may appear through the agency of the organisms ever present and watchful of opportunity to attack.

Symptoms : These begin with the symptoms of bronchitis and in many cases are really exaggeration of those seen in bronchitis. The temperature rises from 103 to 105°F. It may rise higher in cases of severe attack. Breathing is often accompanied by a short moist cough. Difficulty in breathing ensues. There is thick catarrhal discharge from the nostrils. The general impression is that the animal is seriously ill, but it is not like the disturbed painful appearance of croupous pneumonia.

Appetite is not evident. Milk flow diminishes or may cease. Rumination is suspended. The animal stands with extended neck, breathing perhaps through the mouth. The cough is usually frequent and troublesome and in the resolution stage or before

may occur in paroxysms which exhaust the animal. During the stage of resolution there is copious discharge from the nose and finally casts may be thrown out. These are consolidated serous matter which had blocked the bronchial tubes and taken their shape as in a mould. With resolution these get loosened and may be thrown out as small cylindrical pieces.

The disease generally gets cured in two or three weeks, but it may be indefinitely prolonged and occasionally it may develop into chronic interstitial pneumonia.

Treatment : Treatment is the same as in the case of croupous pneumonia. The essential thing is good nursing and provision of plentiful air circulation while the animal is protected from rain and cold. Medicines by mouth may be given in the form of electuries mixed with treacle, so that it may be sucked in like a lozenge. There should not be any attempt to drench, because the liquid may go down the other way through the trachea in an attempt at forced feeding. Attempts should be made to relieve the symptoms as these appear. Inhalations to soothe throat and lung inflammations, and embrocations on the chest are good. Food should be given in small quantities, at short intervals. A prolonged period of convalescence is necessary. Work should be given to working bullocks only very gradually ; otherwise there is a risk of relapse.

In some cases pneumonia develops fast and in a few days covers a large area of the lungs. In other

cases, the development of pneumonia is slow and may extend over 2 or 3 weeks.

Difficulty is experienced in differentiating between bronchitis and broncho-pneumonia. In broncho-pneumonia the high temperature gives an indication, and there is absence of vesicular breathing, whereas the dullness in broncho-pneumonia is in circumscribed areas.

Treatment by M & B 693 should give good results.

1439. CHRONIC FIBROUS INTERSTITIAL PNEUMONIA OR PULMONARY CIRRHOSIS

In this disease the fibrous structure of the lung tissues only are affected. Around the walls of the bronchi and the blood vessels nucliated fibrous tissues begin to grow. These spread to the extent of obliterating the air-cells. The lung at first becomes enlarged, then begins to shrink. It becomes dense in texture and solid, while the unaffected portions become blown out with air space abnormally or become emphysematous. The bronchi are dilated. The pleural membranes get thicker. When the degeneration proceeds further, the lung substance breaks down and cavities are formed. The change is mostly brought about in lungs of animals by parasitic larvæ or by echinococcus cysts.

Symptoms : There is, in the beginning, a general feeling of breathlessness, inablity to perform hard work or work for prolonged periods.

There is a short troublesome cough often mistaken for asthma. Chronic bronchitis may complicate, and in that case cough is very frequent and husky in nature. There is no rise of temperature if the animal is kept at rest. Occasionally animals suffering from pulmonary cirrhosis die of exhaustion.

Treatment : Nursing and rest may do what good can be done. There is no medicinal treatment. The parasites may be attempted to be killed. The growth of cysts, when the disease is due to cysts, cannot be checked by treatment. Sulphapyridine or M & B 693 is recommended for internal asepsis.

1440. PLEURISY OR PLEURITIS

Pleurisy is the inflammation of the pleura or of the serous membrane enclosing the lungs and lining the interior of the thoracic cavity. Pleurisy is often of tubercular origin and the contrary also is true, namely, pleurisy leads to tuberculosis of the lungs.

At first, there is an inflammatory congestion of the serous membrane which may extend to the tissues of the lungs and also of the chest wall. In the next stage fibrin is exuded on the surface of the pleura. The exudation may be in thin, easily-separated pellicles, or they may be forming tough and fairly thick membrane. The two layers of pleura normally remain separated with a lubricant in between, to minimise friction. In developing pleuritis the two surfaces may get joined together in places by bands of fibrin, extending between them.

These growths may interfere with the free play of the lungs during respiration.

After fibrin deposition has gone on for sometime, the next development is the effusion of a fluid in the pleural cavity. It is often a turbid, yellowish sero-fibrinous fluid containing some flakes of solid fibrin. What was only a fold of diaphragm-like parting wall now becomes a sac of liquid. The quantity of liquid in an adult animal may be several gallons. There is no space, however, for so much liquid to occupy in the thoracic or abdominal cavity without interfering with the working of the organs. The fluid in the pleural sac bulges and pushes the organs from their places. The lungs and heart may be pushed away or pressed, and on the other side the liver may be pressed or pushed away.

In favourable cases, now is the time for an endeavour to return to normal. The fluid gets gradually absorbed and the adhesions are freed, which brings back the pleura to normal working condition, and no disease is left.

If absorption does not take place readily, if the fluid is too long in the pleura and if the pressure consequently on the lungs has been long continued, the lungs may be afterwards unable to re-expand when the fluid passes off.

The effect of this is to place the affected portion of the lungs permanently out of work. On account of the compressed or shrunken condition of lungs, the chest wall then falls in and gets distorted, and the affected side does not rise and fall with breathing.

The unabsorbed fluid remaining in the pleural sac may become purulent and emphysema may occur. Gas is produced which in its turn exerts pressure upon the fluid content. In extreme cases the sac may burst, although this happens very rarely in animals.

In one type of pleurisy there is no effusion of fluid, and it is called dry pleurisy.

Causes : Pleurisy is caused by the activity of the micro-organisms which gained entrance to the pleural membranes. These may have come from the chest wall, from wounds or may have reached the site from inflammation of any neighbouring organ or may have arrived by the route of the blood stream.

It has been mentioned in case of foreign bodies in the stomach (**1424**) that they may injure the neighbouring organs. Pleurisy may result from pointed objects perforating the rumen and injuring the pleural membranes. Tuberculosis often causes pleurisy, in which case, it often takes a dry form in the cattle. Attacks of influenza or actinomycosis may result in the pleura being affected by the organism, giving rise to pleurisy, Penetrating wounds from outside may cause pleurisy.

Symptoms : In acute pleurisy there is usually, at the commencement, a sharp attack of pain. The animal becomes dull and distressed. The temperature rises and may be between 103 to 107°F., according to the vigour of the attack. The manner of breathing changes. The thoracic wall heaves less, the flanks and abdominal muscles are strained for the functioning

of respiration. On account of the inability of the lungs to expand fully, the respiration becomes quick and small in volume. Abdominal respiration may be said to be a characteristic of pleurisy. Pain is felt when the chest wall is pressed and the animal may grunt. Pain will also be felt in turning, on account of the flexure involved. A short hacking cough may develop. With the accumulation of fluid, the cough goes, but the respiration difficulty increases.

By percussion it is possible occasionally to sound the level of the fluid. It is dangerously high if the fluid rises one-third way up the line drawn from the sternum to the spine.

Pleurisy is always to be regarded as a serious disease and an animal may expire during the very painful acute stage in two days. Recovery may take place in three to four weeks. When the disease takes a favourable turn, the breathing improves, distressing symptoms gradually disappear, and the animal seeks food.

In chronic cases pleurisy may be dry or may be accompanied by effusion of fluid. The chronic stage may follow an acute attack or the disease may slowly develop and take an acute form. In the dry chronic type it is difficult to diagnose. The difficulty of respiration and exhaustion at slight exercise give some indications. Difficulty is felt in rising or when lying and also in taking turns abruptly. When in the chronic type effusion is present, the symptoms are similar to the acute type; only the pain is not so acute.

Treatment: For relieving pain in the chest-wall, counter irritants in the form of embrocations do good. Preparations like antiphlogistin in which some essential oils are presented in a clay-glycerine medium are useful for application in the form of a poultice. In the early stages of the signs of pleural friction, the application of cold water is beneficial. In the later stages warm compresses are useful. For facilitating retarded absorption, friction massage with camphor liniment is useful, Where there is marked tenderness of the chest wall and cough is of a distressing nature, sedatives are indicated such as opium or *datura*. Opium may be given subcutaneously in the form of morphine in $\frac{1}{4}$ to 2 grain doses.

Thioarsenamine or preparations like M. B. 693 should be given. Laxatives are necessary to keep the bowels moving.

CHAPTER XLVII

DISEASES OF THE HEART

The heart is a very hard-working organ. From the time of its formation in the fœtus up to the time of death the heart is continually working. It knows no rest. Its only rest is in death. When the heart goes to rest, the animal dies. Considering the enormous amount of circulatory work that the heart has to do, and considering that it is working ceaselessly day and night, heart diseases are remarkably few. Again, as diseases are few, their detection and treatment are also difficult. Of course, when the symptoms aggravate, even an ordinary stock owner may say that something was wrong with the heart of the animal. But the true estimation of the gravity of the heart disease or otherwise is a matter, for the determination of which expert knowledge and practical experience for a long period is necessary. Treatment of heart diseases is always a special and a difficult subject.

A general idea is given below regarding some of the commoner diseases of the heart.

The heart is enclosed in a sac; this is called the pericardium. The muscular structure of the heart is called myocardium and its inner lining is called endocardium. There may be inflammations of all these three parts of the organ which are named

pericarditis, myocarditis and endocarditis according to the part affected. Then there may be diseases of the valves of the heart. There are four valves on the two sections of the heart. Their diseases are classed as valvular diseases. They may be stenosed or constricted or they may be incompetent.

The whole of the heart may suffer from what is known as 'Hypertrophy' in which its wall is thickened or it may be 'dilated' in which the cavity is enlarged. The muscular tissue of the heart may be degenerated, leading to the enfeebled action of the heart, known as 'degeneration' of the heart.

Without any of the above structural changes taking place the heart may improperly function leading to 'functional diseases'.

Often no complaints may be observable in the working of the heart in life, but after *post-mortem* examination, one or more defects may be found. The reason is that the heart possesses enormous powers of compensation. If there is weakness or defects in one direction, the heart compensates for that by more strenuous work, and the heart is then a compensated heart. A diseased heart on compensation shows normal working. When, however, this fails, the heart becomes uncompensated and the effects of the disease become evident.

This compensatory motive operating on the heart leads to hypertrophy. When an animal is called upon to do more work than its circulatory system ordinarily permits it to do, then in order to do the imposed work, the heart increases in size or becomes

hypertrophied, and with the increased bulk of the heart, what was ordinarily an impossible job is made possible for the individual. Thus in human beings we have what is called 'athlete heart'. The athletes perform unusual physical feats, and the heart, in order to cope with the extra task imposed, increases in size and becomes hypertrophied. Similarly also, in case of animals that are made to perform extra heavy work. But this thing does not go unpunished. With growing age and the failing strength of the muscles, the animals are not able to perform the tasks for which the heart was artificially made competent. On sinking back to a low level of exertion, the hypertrophied heart has little to do with its extended size. As a result, the heart deposits fat on itself and becomes worse than a normal heart ; for, degeneration sets in on allowing it to remain idle.

Again, all febrile diseases react upon the heart, particularly those associated with bacterial attacks. Influenza, pneumonia, pleurisy. tuberculosis, septic fevers, all throw extra strain on the heart. Chest troubles affecting organs other than the heart reflect on the heart. Stomach troubles owing to the proximity of the organ are likely to affect the heart or the pericardium. Heart diseases may be set up due to the pressure of tumours on the neighbourhood. The pressure may be directly on the heart or on the arteries or on the lymphatic glands.

Heart disease is revealed by the symptoms of breathlessness even on normal exertion, and by marked irregularity of the beat of the heart. Defective

working of the heart exhibits also in the oedema of the dependent parts, also in the dropsical condition of the abdomen. In some cases, there is turbidity of the tongue and congestion of the membranes of the eyes and of gums. These are some of the general symptoms.

1441. PERICARDITIS

Pericarditis is the inflammation of the pericardium or the enclosing sac of the heart. It is generally due to some injury in the case of cattle. But the diseases in the regions of the heart may spread to the pericardium, causing its inflammation. Pleurisy, pneumonia, tuberculosis, septic fevers may all contribute to cause inflammation of the pericardium. In cattle a very fruitful cause is the injury from foreign bodies projecting out of the reticulum which is placed nearest to the heart. The cattle have a perverted desire for eating unworthy objects as food. These have been considered in connection with diseases of the stomach due to foreign bodies. Needles or hat-pins when eaten by the cattle may puncture the reticulum and injure the heart, causing pericarditis.

In acute cases the pericardium which consists of two layers of sheeting juxtaposed, constituting the pericardial sac, may have both its surfaces covered with a layer of fibrin. The sac may be locally filled with serous materials of a more or less putrefactive character, when an object like a needle or hat-pin enters the heart. It may happen that a foreign body

entering the heart is completely enclosed by its muscles or that the foreign body breaks, leaving the wound in the pericardium.

Symptoms : Traumatic (caused by injury) pericarditis lasts for 1 to 6 weeks. There is tenderness to pressure over the reticulum. The respiration becomes shallow and there is pain felt in breathing. The heart beat is accelerated. The friction sound of pericardium may be heard which may disappear on deposition of much fluid. A weak painful cough may be observed.

Non-traumatic pericarditis due to infections usually end fatally. Traumatic cases run a varied course. Sometimes the symptoms may subside or continue to remain in half-suppressed condition.

Treatment : General health should be maintained by regulating diet, which may consist of green food or hay and bran mash. Cold compress should be locally applied with cotton or jute, frequently wetted with cold water. In primary condition, salicylates may be useful. Sodium salicylate in 4 dram doses, repeated twice or thrice daily, may be given.

To promote absorption, laxatives like myrobalan 8 oz. dry powder of pulp repeated twice, aloes in 1½ ounce doses or magnesium sulphate in 1 lb. doses should be given.

1442. MYOCARDITIS

Myocarditis or inflammation and degeneration of muscle fibres is generally of secondary origin from infectious diseases like septicæmia. In malignant

foot-and-mouth disease, myocarditis may develop. The symptoms are those of heart-weakening. The pulse is weakened and accelerated. Cyanosis also may be present. All these symptoms may be retrogressive. But in severe cases the pulse becomes thready and intermittent and death occurs from paralysis of the heart. The course of the disease depends upon the character of the primary infection. It is generally fatal.

Treatment should be on general nursing lines. There should be no movement. Diet should be nutritious. The muscular action of the heart may be strengthened by the use of **arjun**. Subcutaneous injection of strychnine $\frac{1}{4}$ grain may allow a crisis to be tided over.

1443. VALVULAR DISEASES

These form a group of disorders of the heart which is most common. There may be stenosis or obstruction to the discharge of blood through the valves either in filling or in expelling. Or, there may be leaks in the valves themselves. Both these causes diminish the efficiency of the heart. In order, however, to be able to discharge its function the affected portion grows bigger in size, so that what it loses in one direction by obstruction or leaks, is made up by provision of extra volume of the receptacles. So long as the normal rate of circulation is maintained, and the functions of the different organs remain unaffected, compensation of the valvular defect is said to exist. On the other hand,

in some valvular diseases certain organs cannot function properly, their efficiency is affected even when at rest, not to speak of working with normal effort. Then arises dis-compensation in spite of hypertrophy.

When less than necessary blood circulates to the brain, there is a general sleepiness. Passive congestion of the lungs may be brought about by the incompetence of the auriculo-ventricular valve of the left heart (mitral insufficiency) due to regurgitation of the blood back into the left atrium where it hinders the flow of blood coming from the lungs.

The various defects can only be diagnosed by careful examination, requiring expert skill. The various heart sounds tell their tale to the experienced ear, and the defect can then be spotted. It is a difficult matter. It has to be learnt practically from an expert.

When the heart from any cause gives trouble, it is wise to let the animal have rest, and if the defect is a curable one, rest from work and movement may cure it. Cardiac tonics are sometimes useful in securing a compensated condition.

1444. FUNCTIONAL DISEASES OF THE HEART

(1) PALPITATION

In palpitation the heart beats strongly and quickly. The cause may be due to some nervous errors. The palpitation may last for a few seconds or for hours or days, and then subside. During the attack the

heart sounds are increased and may sometimes be heard even from a distance of a few yards. The pulse is weak and the jugular vein gets dilated and pulsating. The animal often exhibits signs of great anxiety, trembling and sweating. When the attack subsides, all symptoms disappear.

In nervous excitement which continues for sometime, sedatives like morphia or opium may be given in severe cases. In less severe attacks chloral hydrate or Potash Bromide may be given.

1445. (2) BRADY CARDIA

It is a condition in which the heart works very slowly. It does not cause any distress to the animal. In some cases the condition is brought about after some severe disease creating this functional disturbance of the heart. In such cases, the normal condition is restored after sometime, although during the pendency of brady cardia the animal is very likely to be dull and sleepy.

1446. IRREGULARITY OR INTERMISSION OF HEART-BEAT

It is quite common amongst animals. Temporary intermission may occur from digestive disturbance or from the absorption of toxins which react upon the vagus nerve. Diseases of the muscles of the heart (myocarditis etc.) may also be responsible for it.

True intermission, following diseases, disappears after the primary disease has subsided or it may

persist temporarily or permanently without affecting the health and the working capacity of the animal. But a more serious condition may arise due to severe heart affections. In extra systolic intermittence there is a rapid succession of two or several heart beats, which are then followed by a longer pause. Bodily exercise aggravates this intermittence. A cardiac tonic like **arjun** may cause it to disappear, at least temporarily.

Animals with pronounced intermittence should be put to work cautiously.

1447. CARDIAC ASTHENIA : HEART WEAKNESS

In this disease the power of the muscle of the heart is reduced. When it happens under conditions of unusual strain, it is called **relative heart weakness**, and when under the usual conditions of life, it is called **absolute heart weakness**.

Absolute heart weakness may appear even when the animal is at rest or during very light exercise.

When very weak or very fat animals, or when an animal after a long period of rest is called upon to perform unaccustomed muscular work, such as their being driven at a speed or pulling a heavy load, **acute heart weakness** may appear. The veins then gorge more blood into the auricle, while the arterial resistance is increased by the powerful contractions of the body muscles, and heart weakness may result as the heart may not be able to push all that blood against the increased resistance of the arteries.

Absolute heart weakness occurs in infective diseases or diseases of the muscles of the heart and from the action of toxins.

Chronic heart weekness develops slowly under the influence of prolonged exertion, during weeks or months. This however, occurs more generally in valvular (**1443**) or myocardial diseases (**1442**) of the heart or in affections of the coronary veins, those that take the return blood from the muscles of the heart itself.

In overstrain even a healthy heart may become incompetent because of the extra amount of veinous blood which the heart is called upon to clear out against high arterial resistance. When the resistance increases still more, the amount of blood delivered out by the heart becomes less and less till a balance between the resistance of the pressure in arteries and the pressure of the heart muscles may get established, and no blood is emptied out of the heart at all, which remains filled up. In lesser degree this happens in all absolute heart weakness, even in a state of complete rest, and the volume of propelled blood remains less than the incoming blood, or a stasis occurs.

In chronic heart disease the above position leads to dropsy and ascites which may eventually spread all over the body. Defective circulation may lead to vertigo and fainting feats. Stasis in pulmonary circulation leads to respiratory troubles and may lead to hæmoptysis. The effects may be felt all round the various organs, the gastric functions may be disturbed, and liver, pancreas and the kidneys are

likely to be affected. Sometimes the liver gets enlarged, the lungs get oedema, and the secretion of urine becomes scanty.

The heart beat is accelerated and becomes palpitating, and the heart is usually dilated.

Treatment: Complete rest is essential in all forms of heart weakness, coupled with nutritious feed and good nursing. If there is digestive disturbance, suitable symptomatic treatment should be made. In case of constipation, castor oil and Mag sulph should be given, so that the faeces may remain soft.

In most cases **Arjun** bark powder in 2 ounce doses, 3 to 4 times a day, may be usefully administered to tone up the muscular contraction, to lower down the palpitation and increase the diastolic output. It takes time for the orally-administered medicines to be effective. A quicker way would be to inject some drugs by intravenous or subcutaneous route. The difficulty is that strophanthin cannot be given, for, there is always the danger of overdosing with it which will result in the death of the animal. This risk may not be taken. Digitalin also suffers from the same defect. Digitalis by mouth is also not recommended because the glucosides may get destroyed in the fermentive process in the rumen. What happens to **arjun** has not yet been found out. It is worth trying, as no harm can result, specially as it has been very effective in the case of man.

In heart weakness for atony, stimulants like camphor in oil may be injected subcutaneously in doses of 1 to 2 drams of camphor, dissolved in oil.

CHAPTER XLVIII

DISEASES OF THE KIDNEY

1448. NEPHRITIS, BRIGHT'S DISEASE

It is a toxic or infective disease of the kidney in which the kidney as a whole may be affected or its glomerules and tubules only may be affected. The inflammation may be in patches, or it may be diffused.

Rarely does the condition come from injury from outside, although when an animal is run over or gored, it may happen. It may be due to poisoning by irritants, such as mercury preparations or turpentine. But the commonest cause is the infection from some dangerous diseases, such as anthrax and septicaemia.

Exposure to cold, chills and draughts, by lowering the vitality of the kidneys render them easy prey to micro-organisms which then create the inflammatory condition. Moulds in fodder or damaged fodder often cause serious injury to the kidney. Influenza and contagious pneumonia sometimes create mischief.

Symptoms: There is albumin in urine which can be found out by the common tests for it. The quantity of urine is diminished. The deposits may show epithelial cells and casts and white blood corpuscles under the microscope. It is sometimes associated with a tenderness of the kidneys. The animal stands with its back arched, and moves

unwillingly. Fever is occasionally observed. Urine becomes reddish.

In serious cases no urine may be passed for several days. The animal periodically sweats profusely.

Treatment : Rest in warm surroundings should be given and no exercise. Non-nitrogenous food should be given, such as gruel, or sloppy bran mashes. Soda bicarb in ½ ounce doses may be given with water several times daily. **Punarnava** green 2 lbs or dry 4 ounces may be given daily as a diuretic.

The bowels should be kept moving with mild laxatives. If there is pain in the loins, a warm rug should be placed over it. Hot wet pack may be given in the region of the loins by dipping a blanket in hot water, wringing and after applying on the loins keeping it covered with a dry blanket.

Serious cases where urine ceases to form, end fatally. Milder cases recover under proper nursing.

An acute attack by prolongation is occasionally converted to a chronic disease. Care after the animal's feed and exercise may keep it in a useful condition for some time, but a seriously damaged kidney is beyond repair. Only palliatives may be given according to symptoms. Proteid food should be avoided. The disease, however, may run a rapid course, death happening in 4 to 5 days.

1449. BACTERIAL INFECTION OF THE KIDNEY : PYELONEPHRITIS

Bacterial pyelonephritis is one of the dangerous diseases of cattle, attacking chiefly cows after calving.

Male animals and calves are rarely affected. Bacterial infection may enter through female sexual organs after parturition. In some cases retention of urine caused by the pressure of pregnant uterus may predispose the animal to bacterial infection.

The bacteria set up local inflammation in the capsules of the glomerule. Then the inflammation spreads to the surrounding tissues. Gradually the lower part of the urinary tract becomes affected, The infection may in the alternative have an ascending course and affect the interior of the kidney from below.

The capsule of the kidney gets thickened. The kidney tissues become saturated with serous fluid. Pus forms and the ureters become thickened.

Generally, there is frequency of micturition with painful straining and tenderness in the region of the kidney. A thick purulent discharge comes out and soils the region of the vulva and the under surface of the tail. The vulva may show catarrhal redness and swelling. There may be superficial ulceration. The urine is generally turbid and shows a high content of albumin. With the development of the disease uraemia sets in and the animal dies of exhaustion.

There is no positive treatment. In early cases the vulva and the interior should be irrigated with an antiseptic fluid. Urotropin may be given internally in 1½ dram doses. There is seldom any recovery. M. B. 693 to counteract the bacterial action may be useful.

CHAPTER IL

DISEASES OF THE BLOOD

1450. ANAEMIA AND BLEEDING

Anaemia as a diseased state is associated with the reduction of the haemoglobin of the blood.

Simple anaemia may be due to several causes :

1. **Bleeding or Haemorrhagic anaemia** : With the quick loss of an excessive quantity of blood, acute anaemia may follow. Thus excessive blood letting, epistaxis, wounds, rupture of large blood vessels, rupture of the liver, haemorrhage from the ovary or uterus or from the lungs in tuberculosis (haemoptysis) may cause acute haemorrhagic anaemia.

2. **Haemolytic anaemia** : This results from haemolysis or the escape of haemoglobins from the enclosing casing and their mixing with the blood plasma. This can happen under the influence of toxic substances. The bite of a certain class of snakes (viper) causes death by haemolysis.

3. **Nutritional anaemia** : This results from insufficient feeding or feeding with materials that are inadequate in certain necessary components for the formation of blood. Such deficiency may be in proteids, carbohydrates, fats, salts such as of iron and copper or vitamins. This may also be caused by harmful constituents in diet. Toxic substances

and moulds, developed in stored fodder, may cause nutritional anaemia.

4. **Parasitic anaemia**: Worms in the stomach or intestines or lung, or flukes in the liver may cause it. Blood parasites, such as piroplasms or trypanosomes, filaria etc. may also cause this class of anaemia. These factors affect the b lood in various ways. The worms may suck blood and cause loss and produce toxic substances which may hinder the natural process of blood formation. Parasites may destroy blood or suck substance out of it.

Effects: When there is a very large quantity of blood lost by bleeding, respiration and circulation may fail. This failure may be due to the fall of blood pressure, and also indirectly by the lack of oxygen which happens, due to the shortage of blood corpuscles.

In case of loss of blood by bleeding, when it is not directly fatal, as it may be, nature immediately sets about to make it good by drawing upon convertible reserves. Fluids are withdrawn from the tissues to increase the bulk of the circulating fluid. Red corpuscles are rapidly manufactured, and in the hurry of the moment red corpuscles containing insufficient red colouring matter (haemoglobin) may be thrown into circulation. Bone marrow is activated to what may called forced production and a number of immature blood cells are thrown into the blood stream. By all these, nature strives to get over the emergency.

In haemolytic anaemia owing to the destruction of numerous blood corpuscles, a similar process

happens. But recuperation is more rapid, as the essential constituents for the construction of blood corpuscles are not lost as in the case of bleeding.

The effect on the system of anaemia is the diminished power of the circulatory system to absorb oxygen and remove carbon dioxide, both of which operate to increase the pulse rate and also to increase the depth of respiration as a compensatory attempt. For the same reasons, blood can only insufficiently remove the debris from the tissues on muscular work, and, therefore, the toxic or refuse substances accumulate in the muscles and create abnormal fatigue.

When an animal is bled to death, all the organs become strikingly pale, specially the lungs. They contain little blood. The heart and the larger arteries become empty and contain only scanty loose clots. In chronic anaemia, however, the organs contain generally their full quota of fluid, but the blood is then pale and watery, and coagulation is slight. In severe cases of chronic anaemia oedema of the important organs is a constant factor.

Symptoms : In acute bleeding, anaemia develops rapidly and proportionately to the loss of blood. Weakness, vertigo, sweating and unsteady gait are seen. Mucous membranes become pale, the pulse becomes quick, small and hard, and later becomes soft and of low tension. There is breathing difficulty and the extremes become cold and cramps may occur. With continued loss of blood the animal loses consciousness and dies in convulsion.

In **chronic anæmia** there is the characteristic paleness, observable specially on the conjunctiva and in the socket of the eye. There is dullness and indifference, which become more and more pronounced with the advance of the disease. The pulse rate is increased on the slightest exertion. There is loss of appetite. Breathing becomes rapid and with the increase of anæmic condition there is œdema of the walls of the abdomen, chest and throat, and then death intervenes.

Much information may be obtained about the stage and character of anæmia by a microscopic examination of the blood and on taking the counts.

Acute **post-hæmorrhagic** anæmia is not a very serious thing, if precautions are taken. The condition may return to normal in a few days on proper nursing and dieting, if much blood has not been lost. It is held that if 50 per cent, or more of blood is lost by external hæmorrhage, the case becomes fatal. A cow has about one-thirteenth of the bodyweight of blood or about 7·7 per cent, which comes to about 4 gallons in a 500 lbs. well-nourished cow. From this an idea can be had of the extent of loss of blood to push it to the fatal point. In internal hæmorrhage, however, which takes place slowly, the animal may survive even after the loss of 80 per cent of its blood. **Chronic anæmia** is curable, provided complications by way of dropsy or of the exhaustion of the bone marrow of its capacity to produce the red corpuscles, have not advanced.

Treatment of bleeding: Bleeding should be stopped by all possible means. If it is external, ligatures should be applied at the appropriate points without loss of time. The coagulability of blood may be increased by injection of sterile albuminous fluid, such as milk at the site of the injury. For enhancing clotting calcium gluconate in ½ ounce doses may be given by mouth or per rectum.

Styptics such as alum, turpentine may be given by mouth.

If the loss of fluid has gone far, it is imperative to make up the loss temporarily by the intravenous injection of normal saline, containing 90 grains of sodium chloride to the pint. It is desirable to add 7 per cent, of gum arabic (612 grains to the pint) in order to impart to the saline a colloid osmotic pressure resembling that of the blood. For this purpose gum arabic should be mixed in paste form with saline and then thinned down gradually by the addition of more and more water so that no lump may be left, strained through double fold of cloth, sterilised by boiling and then cooled for use. By infusion of 5 to 10 pints of saline, an emergency may be met and life can usually be saved even when the loss of blood is as much as 70 per cent. Repeated subcutaneous injection of 80 c. c. of defibrinated warmed blood may be given at various points of the body of the animal, to the extent of 3 lbs. in all. After every injection the fluid should be dispersed by massage. (*Hutyra*).

When recovering from a shock of bleeding, tasteful nourishing food, corn, hay, gruel etc. should be given.

Milk is good. The diet should be given frequently in small quantities.

Treatment of anæmia : Iron may be given in the form of inorganic salt, as Ferrous sulphate in 2 dram doses. Slight dosing with copper acetate or lactate is useful. Copper is put in *dahi*, till it becomes blue, indicating solution of copper in it by the lactic acid of *dahi*, which may then be given. Arseneous acid in 2 grain doses is a very great adjunct in promoting the formation of the blood corpuscles.

CHAPTER L

DISEASES OF THE BRAIN

1451. CONCUSSION OF THE BRAIN

When an animal receives a heavy blow on the head, by a fall or by running against an obstruction or by being kicked, or by being run over, the brain may be injured, although the skull may not be fractured.

The animal immediately on being injured becomes unconscious and all its muscles are relaxed. The shock may be over after a certain time and the animal may get up and walk as if nothing has happened. This may happen only with slight injury. But in the case of a harder blow or injury the animal, even when it regains consciousness, may not be able to rise, and may lose the power of co-ordinated movement. With good nursing these symptoms may pass away after a certain time and the animal may recover. But in very serious cases consciousness is not regained, or even if it returns, there are convulsive fits, and death follows or permanent paralysis of some sets of muscles happen. Vomiting is a symptom of injury to the brain and may happen in all the above class of cases.

Treatment : Absolute rest is to be given. Some stimulants may be given hypodermically. If there

are wounds they have to be dressed, and if there is fracture of the limb it has to be attended to. Interference should be avoided as far as possible.

1452. CONGESTION OF THE BRAIN : HYPERAEMIA OF THE BRAIN

The congestion may be active or passive. Active congestion is caused variously from bacterial action, chemical action, poisons, or parasites in the blood stream.

Passive congestion may be due to the obstruction of the outflow of veinous blood from the brain. Tight ropes round the head or neck or pressure of some kind or other on some veins about the neck and head may lead to this.

In active congestion the eyes become bright and the pupil dilated. The head feels warmer than normal, the pulse is accelerated and so also is respiration. The animal tends to become violent and restless. In passive congestion there is lassitude and cyanosis. The pulse becomes small and rapid.

Diagnosis : By differential diagnosis all infective diseases and the inflammatory conditions of the brain, giving rise to brain symptoms, should be excluded. Certain disorder of the intestines also, producing brain symptoms, should be excluded.

Treatment : If necessary venesection should be performed and blood let out in order to relieve the congestion. Cold should be applied to the head and warmth to the body to make the blood flow away from the brain. Aperients should be given. In case

of passive congestion, attempts should be made to remove the cause by finding out where the veins may have been pressed. Passive congestion may be due to cardiac failure also, and attention should be given to stimulate the heart. Injection of strychnine in ¼ grain doses and camphor in oil may be given.

Camphor	...	...	5 dram
Oil	...	...	3 oz

½ to 1 ounce per injection.

1453. SUN STROKE OR HEAT STROKE

The disease is associated with exposure to excessive heat and great exertion. It may occur to oxen working in the field or to animals packed in railway wagons where both crowding and high temperature combine.

Symptoms: There is weariness, dullness and unsteady gait, with frequent staggering. There may be sweating. Breathing becomes quick and laboured. The temperature rises very high—107 to 113°F. or more. There is shivering, and then follows covulsions and collapse, terminating in death.

Treatment: The animal should be removed to a cool place and the head and body should be douched or sponged with cold water. Cold compresses are to be applied on the head.

Oxen, if taken to work before they have finished rumination, may become susceptible to this attack. This should be avoided, specially when working in great heat. Provision should be made for giving

frequent drinks and rest periods when the atmospheric temperature rises very high in mid-day.

1454. MENINGITIS

The term is applied to the inflammation of the meninges or the covering membranes of the brain and the spinal cord. The brain substance itself may also be inflammed and affected when it is called **encephalitis**, and when the cord substance is affected it is **myelitis** or in a combined case it is **encephalomyelitis.** For our purpose clinical distinction between these forms are not of much moment. Meninges of the brain cord and the brain substance and the cord substance are so inter-related that for our purpose the distinction between all these various affections due to bacterial action on the meninges and brain matter need not be separately considered.

Meningitis is caused by bacillary action and by infection from the diseased condition of distant organs such as from pneumonia, tuberculosis etc. Attacks from pyogenic bacteria is one of the commonest causes of secondary infection, such as that of the tubercle bacillus. A penetrating wound on the skull from a kick, from the hoof, or a thrust from the horn, may lodge pyogenic bacteria directly and cause meningitis.

The irritating influence of the infecting organisms cause congestion of the brain, which is followed by accumulation of serous fluid causing pressure on the brain substance. These inflammation and intra-cranial pressure interfere with the normal working of the nerve cells and as a result cerebral symptoms appear.

Symptoms : The first signs are restlessness and excitement. The animal becomes suddenly restive, tosses its head, lashes its tail, sways from side to side and falls to the ground. Then, there is deeper disturbance of consciousness. The animal does not respond to the accustomed call. Within a short time somnolence prevails. The skull sometimes becomes sensitive to the touch. There is spasm of the occular muscles. The neck becomes stiff. Fever is often present. Appetite is lost.

Disturbance or loss of consciousness, deviation of the eyes, contraction of the pupil, and stiffness of neck are the most outstanding diagnostic points. There is paralysis of the cranial nerves. The whole illness in acute cases may last for ½ to 2 days in the cattle. The tuberculous form usually takes a subacute course. But even here the typical cerebral symptoms may have a sudden onset.

A microscopic examination of the cerebro-spinal fluid obtained by lumber puncture helps correct diagnosis.

All forms of meningitis are dangerous to life. If the clinical picture is typical and the symptoms do not abate and are prolonged to five days or more, the chances of recovery become remote.

Treatment : Application of cold water on the head or douching with cold water for 5 to 10 minutes at a time are useful. Potassium iodide in doses of 2 to 3 drams may be given to promote resorption. Rubbing the neck and the thighs with embrocations is recommended. Lumbar puncture to let out the

excess fluid and thereby lessen pressure on the brain is commonly practised in human cases. In animals it is not so successful. A practised hand may try this. M. B. 693 has proved invaluable in human cases of meningitis. It ought to be equally efficient in case of cattle. M. B. 693, suitable for subcutaneous injection is to be preferred. In cases of great restlessness chloral hydrate may be given intravenously 10 grains in 100 c.c. of freshly boiled water in a lukewarm condition.

The bowels should be kept active, as generally there is no motion once the disease develops. Enema, Magnessium sulphate or castor oil may be used. But nothing by mouth should be given to an unconscious animal. The animal should be kept loose. Restraint causes more excitement. Keeping in a fenced place in the shade is best for the cattle.

In those cases where the animal recovers, weeks of careful management and nursing would be necessary before the animal can be put to work. Meningitis being of an infective character, the affected animal should be kept separately and all discharges etc., should be burnt to prevent the spread of the disease.

1455. MILK FEVER : PARTURIENT PARESIS : PARTURIENT HYPOCALCAEMIA

Milk fever is a peculiar disease of milk cows, milk goats etc. in which soon after parturition there is partial or complete loss of consciousness, paralysis of the hind quarters and occasionally of other parts.

This disease is not really fever as the signs of fever are absent. The disease occurs during and prior to parturition also.

In the great majority of cases the cow is attacked within 8 hours after calving. Some susceptible animals may get the disease at any time during lactation or even when dry. Excitement, undue exertion and fatigue play some part in bringing about an attack. Newly-calved cows sent over railways show susceptibility to attack. The most susceptible age is between 5 and 10 years ; the heifers and second calvers are the least susceptible.

It is a recognised fact that the highest milkers, fed with the most nutritious food, are most susceptible. The better-fed cows affected are not deficiently fed from any aspects of nutrition. Cows kept on square rations in which vitamins and minerals are properly proportioned fall victims to the disease.

Milk fever may not arise until as long as four weeks after calving. Delayed cases are generally mild.

The complete emptying of udder after calving appears to be a contributory factor. The disease has a tendency to recur at every parturition period of the susceptible cow.

Cause : Although the cause has not been absolutely and definitely determined, it has been proved that the principal factor is the depletion of the calcium content of blood at the moment. This is hypocalcaemia. But it is not definitely settled why hypocalcaemia should appear in a well-nourished animal at the time of parturition. Other factors,

it is argued, must be working also. One of these is the disturbance in the working of the parathyroid gland. It is known that this gland is an important one in controlling calcium metabolism. Though artificial interference with the working of the parathyroid gland failed to induce parturient paresis, yet some such influence must be working. For the depletion of calcium from circulation, because of the formation of 3 to 4 gallons of milk, could not account for the phenomenon of the disease. If it were so, heavy milkers would at all times be subject to the disease which is not the case. Neither all milkers ; nor do the susceptible animals during lactation develop the disease.

Symptoms : The animal at first shows erratic behaviour, constant lowing and excited movements. Sometimes there may be muscular spasms, particularly in the region of the head or neck. In a little while muscular weakness is evidenced. The hind legs become unsteady, paresis begins and the cow falls on the ground. She may struggle to stand up but fails and remains quiet. After a time she loses consciousness completely, and rests as if in sound sleep, and makes no response to outside stimulus. Corneal reflex is lost. Sometimes the eyes remain closed. The pupils are dilated. Saliva flows out. Breathing is deep. The pulse is accelerated and goes up to 70, 90 or even to 120 or over. The temperature is raised at first, but later on comes down to near about 95°F. This stage may be reached in a few hours. It continues unbroken for

about a day, when, in favourable cases, the cow gains consciousness and slowly begins to exercise control over its limbs and gets up. When recovery commences the process becomes rapid and in a few minutes the cow may be on her legs. The weakness may persist for sometime, from a day to a week. Relapses may occur, but they are rare.

In unfavourable cases the animals imperceptibly die in an unconscious state from respiratory failure. They may injure their head and cause concussion during falling. Careless attendants in attempts to drench medicine may send the stuff the other way into the respiratory channel and the animal may die of pneumonia.

Treatment : Injury during fall should be prevented. Ample space should be allowed to the cow, so that she may be manipulated in the stall. The cow should be supported in a recumbent position by pillows of straw. If she is allowed to lie on her side tympanitis is sure to follow and may endanger life through suffocation by pressure on the diaphragm and the thoracic organs. The only medicine now successfuly used and recommended is that introduced by Greig, and consists of subcutaneous injection of calcium gluconate and boric acid. Calcium gluconate is given at the rate of 1½ dram per 100 lbs. of body-weight. For a 500 lbs animal :

Calcium gluconate	... 1 ounce
Boric acid	... 1½ drams
Water	... 6 to 7 ounces
	(200 c.c approx.)

The mixture is boiled for some minutes to ensure complete solution. Magical recovery ensues with intravenous injection of calcium gluconate. But it has its dangers, and may cause fatality in some cases. The subcutaneous route is, therefore, preferred. When a rapid cure is necessitated in emergency, as during transport, an intravenous injection of calcium-boro-gluconate can accomplish it. It is, however, safe to rely on subcutaneous injection.

At one time, before the certainty of hypocalcaemia was found out, it was the practice to have the mammary insufflated with air. It consisted of pumping clean air into the udder through the teats. A blunt needle attached to a rubber tube to which an air pump is attached with a cotton filter interposed constitutes the apparatus. The filter is in the form of a metal cylinder with an entrance and an exit tube. The cylinder is made in two halves. The interior is filled with sterile cotton put between two perforated discs. The pump, the tube and the needle should all be sterilised before use. In place of a blunted needle, a milk syphon tube serves the purpose better.

The treatment consists in pumping air into the udder by the way of the teats. When one quarter is sufficiently distended another quarter is pumped, and so all the four quarters. If any of the teats is blind or any quarter has or had mastitis, that quarter should not be taken up for pumping. After pumping the cow is left to herself. There is no need of preventing escapage of air back through the teat by putting a tie over it. It should not be done. If the udder sinks

down to normal condition and the cow has not regained consciousness, then another dose of air should be put in.

The method appearing now to be emperical was discovered by the success in the use of injection of potassium iodide in the udder. That had wonderful effect. It was done on certain suppositions into which we need not go. Afterwards it was found that any fluid injected into the udder brings about cure. Then came the system of introducing air which has been the method quite lately. But now it has been found that the introduction of a suitable calcium salt serves the same purpose and, therefore, calcium-boro-gluconate injection has become the standard method. It was found that the pumping in of air had the effect of increasing blood calcium. Calcium salts from the udder got re-absorbed in the blood. Calcium is present in the udder in large quantities at the time of parturition for the production of colostrum. This is sent back to the blood stream by pumping. After this came the treatment of directly giving calcium, preferably through the subcutaneous route.

It is upon these reasonings that it is advised not to empty the udder by milking soon after parturition. Only small quantities should be milked at a time, say, 1 or 2 lbs. In a paralysed cow there should be slow and limited withdrawal of colostrum. The calf should be maintained on the limited colostrum with additional milk from other cows.

At one time milk fever was a dreaded disease, the mortality being 75 per cent. or over. Now, the death

rate has fallen to insignificance and the stock-man knows what to do. This is about heavy milkers in Europe and America. In India we are aspiring to create heavy milkers. Although there may not be many cases today but the stock-man trying to develop milking capacity should know how to save a cow, should a case of milk fever or parturient paresis occur.

1456. TETANY

Tetany is a condition in which localised muscular contractions, as in tetanus, takes place in some animals. It is a temporary feat of muscular incompetency and may pass off quite easily or in rare cases it may turn serious.

Simply, tetany results from toxication or from some specific disorder of metabolism. In human beings, in children, round worms may cause this (**ascaridiosis**), The same also happens in the animal world. Local tetany occurs in the form of spasms of the muscle of both the fore-limbs or both the hind-limbs, forcing the animal to take particular positions. Sometimes the muscular contraction becomes general. There is spasm of limbs, trunk and neck, and the animal drops in a stiff attitude and lies with the limbs stretched and with stiff neck, while there is twitching of the muscles.

The duration may be only a few seconds or the spasmodic fit may persist for days although short attacks are usual. One attack may follow another ; thus a series of broken attacks may give continuity

to the distress. The difficulty with a prolonged attack is that occasionally there is temporary suspension of respiration. If this recurs often the disease may end fatally.

Treatment : The root cause of the toxication should be determined whether it is in the digestive system or due to **helminthiasis** or if there are metabolic disturbance. The causes should be removed. Sedatives in the shape of morphine and bromides are useful. Treatment with calcium-boro-gluconate injection, as in the case of parturient paresis, may be usefully undertaken. Between the intervals of spasms, alkaline carbonates should be given. If the tetany is due to rickets or to osteomalacia, calcium and phosphorus in suitable doses can soon accomplish cure.

CHAPTER LI

DISEASES OF THE SKIN

1457. URTICARIA : NETTLE RASH

A number of rounded and flat topped elevation-appear on the skin suddenly. The disease may be caused by irritation of the skin by coming in contact with nettle. Disorder of the bowels may also be a predisposing cause. Some particular food stuff may induce urticaria.

Symptoms : The rash appears and develops very rapidly. At first small wheals form. In extensive affection, the individual wheals may coalesce forming raised patches. In some cases after a time the centre may sink giving rise to ring-shaped elevations. Although in simple cases there is no itching but those due to the effect of some chemical irritants may cause rather severe itching. Wheals may occur also on delicate parts such as nostrils, vagina or rectum. Urticaria extending over a large area cause restless-ness. Swellings appearing in the larynx may cause respiratory obstruction and difficulty.

Treatment : Generally the disease lasts a few hours to a few days and disappears as rapidly as it had appeared. No special treatment in necessary except soothing the skin by the application of cold water and rubbing. It is advisable to administer aperients so that in cases connected with digestive troubles or

some other mild toxins, the system may easily get rid of them. In milch cows milk secretion may be suddenly arrested. In such cases the udder should be massaged and thorougly emptied.

Urticaria from Serum Sickness: In some instances immune sera may cause toxins and induce urticaria. Cases are observed after the injection of antisera of anthrax, erysipelas, pneumonia, etc. Cattle most generally suffer from such affection.

It is usually due to an idiosyncrasy of the animal. Certain animals show special sensitiveness to the injection of proteins. The phenomenon may be attributed to anaphylaxis. When a serum is injected, it creates a specific antibody for the protein. There is a fixed incubation period for the formation of these anti-bodies. If in the meantime another injection of the same protein is given it is very rapidly broken by the antibody and may cause anaphylactic poisoning. The incubation period is 12 to 14 days in man. According to some it is much longer in adult cattle.

Urticaria in serum sickness appears in 3 to 4 hours after subcutaneous injection, and in a few minutes of intravenous injection. In cattle urticaria appears all over the body. There is general weakness and dyspnoea, oedema of the lungs and occasionally fever. After a reaction cattle remain insensitive to the same serum for about 8 months.

Cases of death are extremely rare. The symptoms subside in a few hours or a day. The development of anaphylaxis can be prevented or made mild by

injecting a small dose of serum sometime prior to injecting the required quantity. When an initial dose of 1 c. c. is injected followed 5 hours later by the full dose, there was no anaphylaxis in many observed cases. By injection of ¼ c.c. serum 24 hours before the full dose, others obtained equally good results. Serum stored for some time is less likely to cause anaphylaxis. Exertion predisposes to anaphylaxis, and therefore animals should not be worked shortly before or after an injection. Some inject calcium chloride in normal saline to avoid anaphylaxis by what is known as complement fixation.

1458. ECZEMA

It is a disease of the skin in which the surface layer becomes scaly and fissured. The disease often appears abruptly and takes a chronic course. The area is slightly swollen and reddened upon which papules, vesicles or pustules appear. The skin oozes out secretions and a crust is formed which is the characteristic of eczema. The surface itches.

Eczema may occur through keeping the surface of the skin unclean. In such cases eczema appears in the parts unapproachable by the animal for cleaning. Exposure of the skin to damp and dirt is conducive to the attack of eczema. Mechanical causes such as rubbing pressure and friction may predispose a surface. Application of mercury or iodine on skin, the internal administration of irritanls like tar, carbolic acid and iodoform also may be injurious from the point of view of this disease.

Often the disease may be connected with digestive troubles. In renal diseases the excretion of urinary products may cause eczema. Other skin diseases such as mange may also predispose an animal for eczema. Micro-organisms which are normally present on the skin surface may become pathogenic and create eczema.

There is often a specific alteration of the cells of the skin upon which eczematous inflammation may develop.

In eczema the skin surface becomes raw, rough and moist. The thickened epidermis becomes cracked and scaly. The exudations contain protein matter and the continuous depletion of protein may cause emaciation and exhaustion.

In cattle, eczema is generally attributed to negligent keeping and dirty skin. Constant scratching for itching may lead to the formation of an abscess. Eczema is occasionally preceded by the falling off of hair. The condition is slowly progressive.

Treatment : The crusts should be cleaned and the sensation of itching should be removed by the application of analgesics. Application of soap and water should be avoided. Oil should be used. 5 per cent carbolic oil may be used for cleaning and cotton soaked in carbolic oil 5 per cent or salicylic acid in oil 1 to 3 per cent should be used for dressing, and the animal so tied that the dressing may not be interfered with.

In vesicular eczema dry antiseptic powder such as boric powder 10 per cent should be dusted or carbolic

oil 5 per cent or salicylic oil 5 per cent may be applied with a swab. For dusting powder starch may be used as medium in which boric acid or zinc oxide may be mixed (5 per cent). When there is too much oozing, a thick coat of powder on cotton ahould be put in and bandaged. Salicylic acid in dry powder form mixed with equal portion of boric acid may be used for dusting.

These antiseptics may be made into ointments and applied. These will serve the purpose of preventing itching also. In severe cases painting with 1 per cent picric acid solution may do good. Some got good results with subcutaneous injection of sterilized milk 20 c.c. twice a week. Blood obtained from the animal mixed with sodium citrate to keep it fluid may be injected in 20 c. c. doses as above. In man, an application of a solution of papaya milk in syrup is found to be effective. Papaya enzyme serves to kill the micro-organism and bring back health to the skin. Papaya milk is taken and made into 1 to 5 per cent solution with glycerine or syrup. This is to be applied with a swab. A very strong solution may injure the skin and produce ulcers, therefore, a beginning should be made with a weak solution.

1459. DERMATITIS OR INFLAMMATION OF THE SKIN

Dermatitis is the inflammatiou of skin with exudation and changes in the vascular tissues and congestion of blood. It may be due to the repeated moistening of the skin from excessive secretion and

the subsequent decomposition of the secreted matter. Contact of lime with the skin of the feet or of the body may cause dermatitis. It may be caused by the irritating action of ticks snd mites and also as a complication of other inflammatory skin diseases like eczema. Burning and scalding may cause dermatitis.

The skin shows redness, swelling and becomes hot and painful. Ultimately a scale peels off and the skin comes to normal. Sometimes vesicles appear on the skin on the pressure of exudate separating the epidermis. From this stage pus may form, scales also may form and produce an itching sensation making the animals rub the part.

Cold compress with water is effective at the early stages. Boric ointment 10% is useful. Where dermatitis is due to burning, the application of a saturated solution of picric acid is very efficient for relieving pain and for keeping the wound antiseptic. The part has to be kept bandaged after applying cotton soaked in picric acid. To prevent the spread of the infective process as a sequence of suppuration, the surrounding may be injected subcutaneously with a 3 per cent solution of carbolic acid by raising small wheals, injecting a few drops at a place.

1460. GANGRENE OF THE SKIN

Severe injury, burns or chemical irritants may cause the skin to be destroyed or dead. Gangrene of the skin means its death. By taking care from the beginning gangrene may be prevented by antiseptic treatment. But in case of deep burns gangrene

appears at the commencement. Then there is deep suppuration.

In deep necrosis the skin is blackened and becomes converted into blackish, hard, stiff material. This area of excessive injury is surrounded by an area of inflammation. In this area pus is formed and the tissues are separated and cast off, leaving an ulcerated surface. Gangrene and suppuration may cause general infection of the whole system. The dead tissues of the gangrened part automatically separate out by sloughing.

Treatment ; All dead matter should be surgically cleaned and the wound dressed antiseptically. The animal should be carefully nursed and when an extensive area is involved, it should not be allowed to lie down on one side but should be occasionally turned and the side changed. The wound should be protected with a bandage which must not be too tight.

1461. ACNE

It is a disease associated with the sebacious glands where nodules are formed causing pain on pressure.

It is caused by sweating and subsequent adherence of dirt and dust helped by pyogenic micro-organism like staphylococcus. It mostly occurs in horses and dogs. Under their harness or collar, where mechanical irritation combines with the actions of sweating and dirt on the skin. It is found also in cattle generally at the end of their tail. The lower invertebrate part of the tail to about 20 inches is mostly affected. It is caused by the soiling of the tail with faeces and

subsequent pyogenic infection. The hair falls off and the skin becomes thickened in patches. Papules appear and they change to vesicles, which exude after bursting. The skin gets covered with crusts and suppuration takes place. Beneath each crust there is a characteristic plug of white material which is the remnant of hair follicle. The depression caused by this eventually gets filled up by granulation which come up and protrude in red, wart-like masses. There may be ulceration causing much injury. Deformity also may result. Necrosis also may follow as the after-effect of the attack.

Treatment : The part has to be cleaned of all dead matter and pus. The cleaned part may be painted with tincture of iodine, 5 per cent Acid salicylic ointment may be applied over the iodine paint. Cleaning is preferably done by washing and rubbing with a saturated solution of soda bicarb.

1462. RINGWORM : TRICHOPHYTIA

Ringworm is caused by a fungus Trichophyton. This disease of the skin progresses in an expanding circle which is its characteristic. The skin is filled with exudates and crusts and scales. It is a contagious disease and can be communicated by rubbing a healthy moist portion of skin with the fungus containing crusts. The disease can be communicated from man to young animals, and from cats and horses to cattle and from cattle to sheep and goat. Contact with infected men in grooming, and use of the soiled coverings from an affected animal serve to

communicate the disease. Sun and fresh air and clean dry skin are to an extent inhibitory to the growth of the fungus. Young animals with thin skin and dark haired animals are most susceptible.

The fungus thrives on the epidermis and does not penetrate deeper down the skin. But the toxins exuded by the fungus in its life process penetrate deeper in skin and cause injury and makes it exude serous fluids. The fungus may cause the hair root to die, as a consequence of which the hair is shed. In another type of the disease the hair breaks off, leaving a short stump. In this type vesicles appear, and often there is scaling off of the surface. It is called the tonsim type, forming what is known as the crusted ringworm. There is considerable effusion of exudate which get entangled with hair and there are proliferations, forming rugged elevations.

Ringworm circles do not expand indefinitely. After a time the progress ceases. This may be due to the production of antitoxins in the surrounding area. In cattle the tonsim type is most common. The protuberances here become covered with a fibrous crust which go up increasing in height by successive deposits and may measure one fourth inch in thickness. These crusts at first firmly adhere to the bleeding surface below it. When in the bleeding area pus accumulates the crusts are broken and on removal, pits of pus become visible. After the detachment of the crust, healing begins.

Calves generally have ringworm on their face, near the lips which forms crumbs like bread. Those

on the lip interfere with sucking. The part is tender. Itching causes distress and interferes with nourishment and growth.

Treatment : The hair should be clipped and the part softened with soap and water. Soft soap may be kept applied to the spot for 2 to 4 days. The softened crusts are to be scraped off and the process repeated till fresh clean surface presents itself. After that salicylic acid 10 per cent as ointment should be applied. Alternative treatment after cleaning and scrubbing consists in painting the site with 5 per cent milk of lime and then washing with 2·5 per cent warm soda solution. Daily application of tincture iodine, where the patch is small, can be undertaken.

Animals should be put under restraint so that they may not rub off the pad of soft soap, and subsequently the ointment that may by applied.

1463. MANGE : SCABIES

It is a disease of the skin created by mites. There are three classes of mites that may lodge themselves on the cattle as also on other animals and according to their nature mange is classified as sarcoptic mange, or the mange from the burrowing mites, psoroptic mange and chorioptic mange. The sarcoptic form is the commonest in cattle, and the scabies created may be generalised over the whole body.

The mites can be seen with the help of the naked eye although they are like minutest specks. They can

be identified with the help of a microscope by comparing with the illustrations and descriptions of these mites into which we need not go.

In cattle, mange may be found to have developed from the mites in its own surroundings without a traceable infection from other animals as a disease of

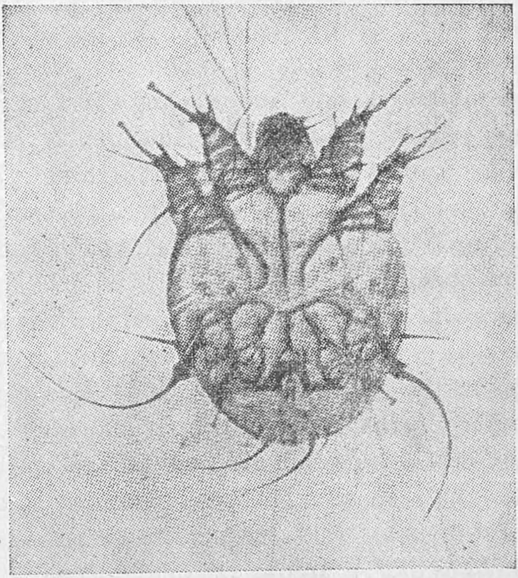


Fig. 125. Diagram of a sarcoptes enlarged.

the stall-fed cattle. It is associated with intense itching. Sarcoptic mange usually begins at the head and extends to the neck. The mites are active in warmth so that when the animals are exercised or artificial warmth is applied they cause greater irritation. The sarcoptes gets its nourishment from young

epithelial cells which it devours in course of its excavations. It may also live upon the lymph and the blood from the papillae which it causes to rise on the skin. The psoroptic mites live upon the surface of the epidermis beneath and between the crusts. With the help of their sharp suckers they suck blood and lymph from the depth of the skin. Chorioptic mites feed on the horny layer of epidermis which after its destruction remains as dusty deposit.

These mites excrete an irritating substance in the epithelial cells of epidermis or into punctures in the skin. This causes the irritation and itching ; besides this, there is the irritating mechanical action due to their boring or travelling with their rough and sharp bristles on them.

On account of the injury caused by them to the skin there is a serous secretion, and an eczema-like conditon of the skin develops. The hair begins to fall because of the eating away of the roots. The same action causes keratinisation of the epithelium about the hair roots. The skin becomes thickened and thrown into folds which is another of the characteristics of the sarcoptic mange. The chorioptic mites on account of their very mode of living on the surface layer cause only slight and superficial injury to the skin. There is itching but there is no exudation, the surface becoming only dry and powdery. The chorioptes choose folds of joints etc. for their habitation, for the protection afforded by these.

The severe itching and gnawing, rubbing or scratching by the animals injure the skin and in case

of extensive surface being affected, there is progressive emaciation leading to cachexia, and ultimately to death.

The more fatty parts of the skin are avoided by these mites.

In sarcoptic mange in the cattle, the crusts consisting of epidermal scales, dried blood, hair, mites and their eggs may be over a third of an inch in height and consequently the skin becomes thrown into folds. The skin on the neck may be thrown into folds of an inch or two that cannot be smoothed out by bending or stretching the neck.

Treatment : The skin has to be carefully cleaned with soap and water. Insecticide fluids or liniments are applied and kept on for 3 days. When the injury is extensive, only patches should be taken day after day, the medicament being allowed to remain till the whole surface of the body is covered. Ten per cent decoction of tobacco with some kerosene oil and soap made into emulsion is one of the best insecticides suitable for this disease. Carbolic acid, cresol, in 5% strength may also be emulsified with soap and used. Crude oil 5% in emulsion serves the purpose, but is likely to exercise a poisoning effect.

1464. TICKS

Ticks are much larger than the mites, belonging to the same class, arachnoides. Ticks are of two families, the hard and the soft ticks. They are flat when fasting but become spherical on sucking blood.

The females when sucking blood become many times larger than their original size.

The ticks (ixodidae) travel up to the body of the cattle and copulate there. After fertilisation, the females fall off. They begin to deposit eggs on the floor of the stall, in chinks, in walls or amongst grass. These are hatched in 3 to 6 weeks into yellowish six-legged larvæ. They feed on the material left in the shell of the egg till they get a chance to get some suitable host.

There are peculiarities of these ticks about reaching the adult stage. Some reach this stage on the same host, as the boophilus tick, creating tick fever. Their life history has been described under tick fever. There are other varieties of two-host ticks in which the larvæ moult on the first host and go to the nymph stage and then fall off. After again moulting, the adult comes out which gets on to a new host. There are similarly three-host ticks also for completing their cycle of life.

Ticks cause serious injury besides the diseases that they bring about. Some of the ticks in search for hosts fix themselves against blades of grass or leaves or twigs of bushes and wait with their fore feet in the air ready to stick to any cattle passing by. They fix themselves to their skin and bore in their suckers deeply into it where they manage to lock themselves. It is impossible then to brush off or pull them without breaking off their embedded parts. When they had sucked blood to the full, they enlarge the hole and then draw out the mandibles. There are

ticks that may suck about ½ c.c. of blood, some suck less. Thousands of them sucking blood at that rate can reduce the blood content of the animal very materially. The toxins from their saliva probably have the effect of breaking the red corpuscles also. Growth is stopped ; milk yield is reduced and emaciation naturally follows where ticks have got a good hold on the animal. Sometimes paralytic symptoms arise from tick infestation. In extreme cases the animal may stagger, fall down and become paralysed. In case of the paralysis of the respiratory muscles, death may occur.

The skin becomes rough and uneven. The neck, umbilicus, thighs and teats are the parts mostly chosen for blood sucking by the ticks. When they are crushed out, their mandibles, remaining broken under the skin, create pustules, and even ulcers may form.

Treatment : It is hardly possible to separate a tick from the body without breaking its head portion with embedded mandibles. There is not much relief to be obtained by combing. A better way is to apply insecticides. In Arabia they give 6 ounces of common salt to the adult cattle with their feed and half the dose to calves. The ticks fall off from the third day, and on the fifth day the animal is free from parasite. It is not known if this method has been tried in India.

A tobacco kerosene parasiticide has been described. Spraying this on the tick-infested surface is a sure way of killing the ticks on the body of an animal. **(1349)**

The more difficult task is to free the stalls of these pests. Lightly burning the surface and turning it over

and again burning may improve the mud floors. Where pastures are heavily infested they have to be avoided for the season and the ground cultivated to get rid of them.

1465. LICE

Sucking lice are blood-sucking parasites. The females lay pear-shaped eggs attaching them to the hairs. In 10 to 15 days these hatch and the hatched-out nymph passes through three stages to the adult form in about 2 weeks. The adult animals copulate as soon as they emerge out as adults and the females begin laying eggs after one day. They can live without food for over a month. Biting lice are also similar to the sucking lice. These parasites are found chiefly on the head, neck and feet.

Severe itching is caused by the lice. The itching intensely disturbs the animal. There is constant attempt at rubbing or gnawing the site. They can be easily detected on inspecting the infected surface of the skin.

Lice are killed by the application of kerosene and turpentine. The eggs are not killed. The operation has, therefore, to be repeated after about 10 days in order to kill the next crop. A third application may also be necessary to finally get rid of the infestation.

1466. WARBLE FLIES : BLOW FLIES

Warble flies are dangerous pests to the cattle. They cause very great economic loss by the lowered

vitality of the fly-infected cattle, by reducing their milk yield, by seriously interfering with their growth and by spoiling the hide with large bore holes. The fly causes great damage in Northern India. In Baluchistan 90 per cent of the goat skins are damaged by warble holes. Much mischief is done in the N. W. Frontier Provinces and the Punjab and the other drier parts of India.

The warble fly is a little over half an inch long. In season it follows the cattle or creeps up to them from the ground and begins to deposit eggs. The flies have a very short duration of life but during these few

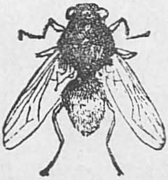


Fig. 126.
Warble Fly.

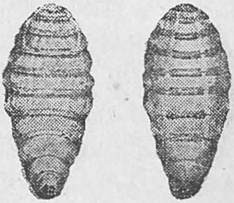


Fig. 127.
Larva of the Warble Flies.

days they lay an enormous number of eggs on cattle and become the source of severe mischief. The flies lay eggs at the roots of hairs in pretty quick succession. In a few minutes they may deposit several hundred eggs. The eggs are very small, about a twentieth of an inch long. The larva emerges from the eggs in 3 to 6 days, and crawls along the hair and works its way under the skin. At this time they are even smaller than the eggs, being about $\frac{1}{50}$th of an inch long. Under the skin it lies for about

2 months. The mites have some routes of migration along which they travel through the internal organs and muscles of the body of the host and at last emerge out at the back of the animal under the skin. Here the larva bores a small hole from below in the skin and attaches itself to the hole by its posterior spiracles. At this stage, it requires air for its existence This enters the larva through the hole in the skin of the host. During the migratory stage the

Fig. 128. The Warble Flies in dorsal and lumbar regions of an ox.

larva attains to a length of about half an inch. After having pierced the skin it begins to moult. After the second or final moulting the larva attains to a size of from three-fourths to one inch.

Attaining to this stage the larva leaves the host animal. It had completed its mischief to the host. It then enters the pupal stage under leaves, on the

ground, and the new fly emerges out of it in about a month and the female fly after copulation begins its career of depositing eggs on the cattle.

When the larva bores out from inside to open the skin, its large size causes nut-like elevations on the skin. They are embedded in pus here. The skin is spoiled by the bore hole, which is enlarged sufficiently to let the large diameter of the larva pass out.

The cattle somehow scent the danger that lies ahead if the warble fly deposits eggs on it. It is believed that at the time of ovi-deposition of the warble fly, the animal becomes excited, tosses its head and kicks its belly with the hind legs. The animal may run into water or enter thickets and there lie for some time to avoid the warble fly.

The swelling due to the larva is noticeable in the dorsal, lumbar and sacral regions. At first they are small elevations only. The size increases and the elevations come out prominently. This is the stage when the larva prepares to leave the skin from under it. The opening comes out, swells at first but readily enlarges to about a third of an inch. A purulent exudation comes out and gets fixed to the hair around. After escape of the larva, the swelling subsides and then completely disappears, leaving a scar covering the hole in the skin. Sometimes anaphylaxis occurs owing to the absorption of toxins from the larva which may have perished of itself or been killed by pressure intentionally. The toxins react on the body when a new attack comes and anaphylactic symptoms appear.

Prevention : Since warble flies come into being from the escaped larva from the skins of animals, if the larvae are destroyed on the body of the animal, there can be no further production of the fly. The combined effort on the part of cattle owners can, therefore, rid an area of the fly. Legislation enjoining upon owners the duty to destroy the larva has been enacted in several countries. In Denmark where 30 per cent of hides used to be damaged by the warble has only three per cent so damaged now, and in time it may altogether disappear.

The methods of destroying larva on the skin are various. The mature larva may be squeezed out of the hole or extracted with a hooked needle or killed on the site by pressure and then allowing some fluid to pass out, extracted easily with a hooked needle.

Application of insecticides is, however, a better way of killing the larva on the bodies of animals.

In Switzerland they rub the wetted backs with common salt or they bathe the part with concentrated salt solution. 80 per cent of the larvae are said to be killed in this way. Creolin in 10 per cent solution is effective. Derris powder (containing 9 per cent rotenone) is extracted with nine times water in the cold by allowing the mixture to stand for 24 hours with occasional shaking. The extract is mixed with some soft soap. The solution is rubbed in with the hand. The application is repeated the next day. 100 per cent of the larvæ get killed by this treatment. But the most suitable treatment appears to be the

application of tobacco extract as in the case of ticks. In Great Britain this is used.

Lime	...	1 lb.
Water	...	9 lbs.
Tobacco powder	...	4 lbs.

Allow to stand with shaking for 24 hours, then strain. The liquid is to be applied fresh. It is reported that treatment by chemicals has proved unreliable in Denmark where they rely on the mechanical method of extracting the larva with a hooked needle.

1467. HUMP SORES

Cattle are often seen to suffer from ugly hump sores. These sores generally begin with pecking by crows. When a wound is once formed irritation sets in on account of the formation of scales from the exudation. These mount and the sore extends in a circle. Sometimes cup-shaped wounds are formed with rugged elevated edges and having a central soft core. In cases of low vitality, sores formed by wounds from injuries take this character.

These sores are very difficult to heal. It is allowed to continue quite as much for want of a suitable remedy as for the pecking of crows which the cattle allow probably as a relief to the irritation caused by the sores. The peckings sometimes are so severe that good pieces of flesh with scabs are taken off and bleeding occur, without any resistance being offered by the animal.

Treatment : The sore should be cleaned of scabs by the application of a paste of tamarind for one or two days. This paste softens the surface and the scabs are removed by rubbing and washing, leaving a clean white surface. Upon this is applied the following ointment

Tobacco leaves in powder ...	1 part
Litharge or Mudra Sankh powder	1 part

Made into a paste with cocoanut oil or vaselin.

The paste is applied and allowed to be on the surface for a day. The sore is again cleaned with tamarind if necessary and the oinment is re-applied. The treatment has to continue for weeks or even for months. The healing is disturbed by renewed pecking or by scratching of the wound by the horns. These have to be prevented. A stick tied across the horns prevents the horns from approaching the body surface.

Of all the remedies the above has been found to be the best. After the sore is healed a scar is left, which after a time gets covered with hair and the disfigurement is repaired.

CHAPTER LII

DEFICIENCY DISEASES

Deficiency in nutrition is the cause of several diseases. Deficiencies are of two classes, (1) Vitamins, (2) Minerals.

Of the vitamins, deficiency of vitamin A is most marked in cattle that are stall-fed and kept on dry fodder from year's end to year's end. In such cases the cows suffer from sores, from debility, weakness and emaciation, and their œstrum is delayed. When the cows conceive, they give birth to still-born calves or calves that die shortly after birth, or the cows become sterile. Vitamin A deficiency opens the door for various infective diseases, and parasites also get stronghold in such weakened systems.

Vitamin A deficiency leads to weakening of the resisting power of the skin and makes the skin function deficiently. Skin, conjunctiva and mucous membrane get affected. Keratomalacia, purulent discharge from eyes, and blindness follow.

All these have been described in connection with nutrition to which reference should be made.

The deficiencies due to minerals also exhibit themselves by producing various diseases. Rickets is due to shortage of calcium or phosphorus or of both. In rickets the bones get weakened and distorted.

1468. RICKETS

Rickets is a disease of the young animals under 1 year old, in which they suffer from weakness, and there is a tendency for the ends of the long bones to be enlarged.

The reason for this state is the inability of the bone-forming cells to abstract the necessary bone-forming minerals from the blood stream and utilise them for making strong, hard bones. It is now believed that absence of vitamin D or absence of calcium and phosphorus in the ration causes rickets.

The absence of calcium and phosphorus or their presence in unsuitable proportion leads to imperfect calcification of the tissues concerned, and also leads to decalcification of bones already formed. Rickets shows itself at the quickest period of growth when growth outstrips the supply of minerals in the food.

A common cause of rickets is the relative insufficiency of calcium or phosphorus due to imbalance between the earthy bases and phosphoric acid. Earthy alkalinity is expressed by the symbol E.A.

$$E.\ A. = (Cao + Mgo) - P_2 0_5$$

In cattle the value should be positive to the extent of +(plus) 25 milligrams for very young animals. Corn and seeds have all a negative E. A. value. When the various organic acids in diet become excessive, then feeding with the minimum of calcium phosphorus may lead to rickets. The presence of excess of oxalic acids in food-stuffs such as from feeding too much on turnip leaves, or of excessive lactic or tartaric acids in food stuffs may lead to rickets.

In the development of rickets, although all the bones in the structure are affected, the bones most affected are particularly those that at the time were developing at a rapid rate.

Digestive disturbance sometimes precedes the actual symptoms of rickets. Some animals develop pica or depraved hunger at the onset of rickets. In some cases the disease at the start creates disturbance of movement. The bones become painful, before distortion occurs. There is stiffness and a partial paralysis of the hind-legs. The gait becomes more abnormal as the bones begin to bend with the advance of the disease. The extremities of the long bones being affected, the joints become swollen and hard. The ribs become bent inwards as a result of the pressure of the shoulders. Muscular atony occurs in the limbs and shoulder blades. The spine may become curved to one or other side, or upwards or downwards. The jaw bones may become tender and cause difficulty of mastication.

The disease generally runs a chronic course for several months. Recovery may be spontaneous in some cases, but generally if the defects are not corrected and proper treatment given, complications arise in addition to deformities and stunted growth, and death occurs.

Treatment : When the cases are not far advanced, rickets may be controlled and recovery effected by providing for the requisite supply of the mineral salts and of vitamin D by exposure to the sun. Green food is best. Where pastures do not contain

the necessary quantity of the requisite minerals, green fodder should include leguminous ones. But it is necessary to supplement green feeding by direct feeding of calcium and phosphorus. Calcium may be given in the form of carbonate or chalk, but still better is the feeding of both calcium and phosphorus in the form of powdered steamed bone-meal in 4 oz. to 8 oz. portions daily.

Rickets may be wholly prevented by taking care in feeding and including some steamed bone-meal in the daily ration in areas or seasons where and when the calves suffer from the disease.

1469. OSTEOMALACIA : FRAGILITY OF THE BONES

What rickets is to the young, osteomalacia is to the adult. It is a disease mostly found in pregnant and in high lactating cows. It is due to the defect of phosphorus-calcium metabolism in grown-up animals. Bones are subject, like other tissues, to continuous modification. In osteomalacia, replacements in bone tissues remain uncalcified and the existing bones are re-absorbed in excessive quantities and replaced by uncalcified tissues, so that what was a strong bone normally becomes, on account of the disease, weak and fragile.

In osteomalacia the tendency of the bones is to break rather than bend. Bending is the rule in the case of rickets. The reason is plain. In adults, when the formed hard bones are subjected to re-sorption owing to deficiency of the proper proportion of calcium-

phosphorus in the blood, the bones become weak but the calcified portions that remain are too strong to bend. Therefore, under the weight of the body or due to the stress of muscular action the bones break.

In the developed stage of the disease the cavity of the tubular bones becomes expanded and the casing becomes thin, spongy, soft and brittle. Short and flat bones become similarly brittle. In some structures, however, bending takes place.

In the case of osteomalacia, secondary affections may follow in the form of anaemia, œdema and atrophy of the muscles attached to the affected bones.

Symptoms : Pica is a prominent symptom. The animal licks and gnaws hard objects that it happens to come across. Calcium-containing articles specially attract it, such as bones, earth, mortar, bricks. There is at some stage a perverted desire to swallow evil-smelling things like urine and fæces. The hunger for placenta that some cows show may really be an exhibition of pica, inidicating insufficiency of calcium in the feeds. Even carcasses may be eaten, and in extreme cases cattle may be found to gnaw one another. The animal stands with its back arched, gets up and moves unwillingly. The animal is in agony. There may be inflammation and swelling of the joints of legs.

In attempts to rise or lie down the weakened bones may fracture. The ribs, the pelvis and the long bones of the extremities are the ones mostly affected.

Treatment : Treatment is the same as in the case of rickets. Nutritious food, addition of bone-meal and light exercise and sunlight are needed.

CHAPTER LIII

CONSTITUTIONAL DISEASES

1470. PARALYSIS : PARESIS

Paralysis is the loss of muscular control over one or several organs due to defects in the nervous system. When the loss of control is only partial, the state is indicated by the term paresis, for example, parturient paresis of milk fever. When one side of the body is affected and muscular control lost over it, it is called **hemiplegia** When the whole body is practically involved by the paralysis of both the sides, it is called **diplegia.** When there is paralysis of the limbs below a certain level of the body, it is called **paraplegia,** and this is the commonest form of paralysis.

When the spinal cord is injured, as in the case of broken back, all that portion that lies behind the injury goes out of control. Paralysis may affect the sphincter muscles of the bladder and of the anus. In which case there is continuous dribbling of urine or of fæces.

Paralysis is a most difficult disease with cattle as with men, but more so with the large animals. When important limbs go out of control or one side is put out of action, or worse, if both sides are affected, the man has to depend upon others for the slightest needs of feeding or changing sides or voiding urine

and stool. In large animals because of the great weight, it becomes almost an impossibility to properly nurse the animal. So long as it lives, it has to suffer. Even when there is a chance of recovery, it takes several months or a year for the nerves to get into proper working condition. Even then recovery is problematical. The animal may have to be painlessly destroyed on humane considerations.

Treatment : Massage, embrocation, and use of galvanic current may be tried in cases of slight and localised attack. Nux vomica powder in 20 grain doses may be given to tone up the nervous system. The animal should be kept on meagre diet and the bowels should be kept moving. Nursing is the greatest factor in the treatment of paralysis.

1471. ARTICULAR RHEUMATISM : RHEUMATIC POLYARTHRITIS

It is an infective disease, involving serous inflammation of joints in acute or chronic form.

It is most common in cattle, particularly in milch cows. The disease is caused by infection with pyogenic organism which create toxins, and these toxins create inflammatory changes in the joints. Bacteria may be directly involved in the creation of inflammation at the joints. Generally, it is a case of secondary infection by the bacteria or their toxins which reach the joints from some distant place by the blood stream. Some investigators believe that rheumatism of joints is due to a phenomenon of

allergy developed by the secretion of toxins in some remote region of the body. This is confirmed in the case of men when it is observed that 80 per cent of the cases of acute rheumatism are preceded by tonsilitis. In animals similar effects have been seen, pharyngitis, metritis, mastitis, all working for bringing about articular rheumatism.

The disease shows itself suddenly as in man, one or several joints being affected simultaneouly or one after another. There is fever, temperature rising to 105—106° F. Then there is acute pain and the joint gets swollen. The animal shows lameness in movement. Sometimes lameness first draws the attention which is followed by fever. Other organs may be involved ; in serious cases, causing peritonitis, pleurisy or pericarditis etc. It mild cases the animals recover without developing complications.

In puerperal arthritis, generally only one joint is affected shortly after child birth. Injury may induce arthritis in susceptible patients. Tuberculosis predisposes an animal to arthritis, just as tonsilitis etc. do. In the case of tuberculosis, only one joint is generally affected. The animal becomes lame and may remain so or if the disease spreads, the animal may be unable to rise and may be lost thereby. It is thought that when one joint is affected, the toxins and organism find their entrance into the blood stream and affect a number of joints simultaneously afterwards. It is, therefore, imperative that treatment should be begun at the first appearance of the disease.

Treatment : Sodium salicylate 30 grains in 10 c.c. of water is to be injected in the joint once a day for some days till the pain and swellings disappear. It is better than giving sodium salicylate in one ounce doses by mouth, three or four times a day. The animal should be detoxicated by the evacuation of bowels by the use of magnesium sulphate in 1 lb. dose, divided into two short intervals. Castor oil emulsion containing 1 lb. of oil may be given for the same object. Salicylate injection gives ready relief and a quick cure. The disease may return, when the same course of treatment has to be adopted. One attack may predispose the animal to several attacks. It is, therefore, necessary to keep watch and see to free purgation by administration of aperients whenever necessary.

Local applications of liniment containing camphor, turpentine etc. is useful.

CHAPTER LIV

FEMALÆ DISEASES

1472. MASTITIS OR MAMMITIS

Mastitis is inflammation of the udder. Generally it appears suddenly and is caused by some one or other of the pyogenic bacteria. Some of the bacteria are present normally in the first milk drawn out of the teats. They are not pathogenic at that stage. Changes from inside or outside cause these bacteria to become harmful and attack the tissues. In the inflammation of mastitis, the tissue substance of the udder is affected, where changes occur, preventing the formation of milk in milking cows. Dry cows are also affected, but rarely. In them also the tissue changes are so brought about that unless the udder comes to normal the affected quarter of the udder will fail to form milk after calving.

Mastitis may affect one quarter of the udder only or several or all quarters at the same time or at intervals.

Heavy milkers, having large and sensitive udders, are most affected. The poor milkers rarely suffer from the disease. This is but natural. In heavy milkers the tissues and muscles in the udder are in a high strung, sensitive condition. Any abnormal condition may break down the balance and cause the tissues to be affected.

Very commonly a heavy milker may get the disease in an acute form a few days after parturition when the system has not had the time to recover from the strain of calving and the cow is in a delicate condition. Infection generally enters through the teat canal, or as has been said, non-pathological micro-organisms inhabiting the teat canal may become pathogenic on account of the peculiar situation. Anothor very fruitful source of infectiou is from an already affected cow. Cows suffering from mastitis form pus in the affected quarter. If the pus is spilled on the floor, the pyogenic bacteria may find entrance into the teat of another cow in the stall by spreading through attendants treading on the floor and carrying some pus contaminated dirt or dust to the stall of another cow. Milkers milking a suffering cow carry the bacteria in their fingers. On using them without an antiseptic wash for milking another animal, bacteria from the soiled fingers enter the teats or may contact the surface of the udder from which they find easy entrance into any of the teats. Cold is a predisposing cause. Sudden cold, particularly if the udder is exposed to it, may cause the udder to swell when all the symptoms of mastitis may follow. Wet floors are a frequent cause. Mechanical injury to the udder such as from kicks or blows or treading upon by another cow may inflame the udder with consequent mastitis. Scratches on the udder from milkers nails or from brambles or fences may invite bacterial invasion.

Symptoms : Swelling and pain of the udder is the first visible symptoms. The udder feels hard and

solid and is very sensitive to touch. If only one quarter is affected the other quarters also become to an extent sensitive, and milk secretion diminishes. With the progrees of the disease one quarter may remain specially affected, but the whole udder may become stiff, and there is no milk to be obtained from any of the teats. The inflammation passes off gradually, leaving one or more quarters useless for milk formation and permanetly injured for the life time. The teats of these udders are called 'blind' teats. Sometimes there is a compensating action on the healthy quarter which increases in size and gives some more milk; but the loss even of one quarter cannot be fully compensated. When one quarter is affected, there is risk of the other quarters being affected and lost in the same or subsequent lactations. The lost quarter suppurates. There is some pus always from the teat of the affected quarter, which comes out on squeezing. And this forms the source of danger to the healthy quarters, for thus it becomes easy for infection to spread. Some times cows lose one after another all the four quarters. Such cows if served by a bull cause mischief, because the new-born calf has to be maintained artificially, and this rarely succeeds because the calf from birth is deprived of the protection of colostrum against bacterial attacks. Either navel ill or white scour or something else causes the death of the calf. A cow that has lost all the four quarters and has got all the four teats blind should be kept away from being served.

Mastitis should be prevented by taking care of the hygiene of the udder and of the milkers hands. When there are cows with blind teats, they should be milked last. In the same cow the blind teat should be cleaned out daily before milking the active teats and the hand disinfected. The discharged pus should be received in a vessel containing sawdust so that it may be burnt off without allowing the floor and neighbourhood to be contaminated. The teats of all milkers should be wiped dry after milking. If there are any scratches observable, tincture iodine should be painted on that teat.

Treatment : The whole of the udder should be fomented. Warm oil should be massaged and then a piece of flannel or blanket wrung out of hot water should be applied to the udder; while this one gets cold another hot one should be applied. This may be continued for an hour 3 or 4 times daily. Rubbing in of anodyne liniment is helpful. Application of materials like antiphlogistine after fomentation, has better chance of quickly subsiding the inflammation. In this case the udder, after the application of the stuff, is to be wrapped in cotton and bandaged with sling from over the back and kept over-night. In the morning after an inspection, the same process may be repeated for the day. The udder has to be relieved by milking out whatever fluid accumulates. In spite of the pain, attempt should be made to empty the udder because accumulated matter will accentuate irritation and keep up cause of the inflammation. Use of sulphapyridine or M. B. 693 is recommended Injection of polyvalent strepto vaccine is useful.

1473. METRITIS : PUERPERAL FEVER : INFLAMMATION OF THE UTERUS

Uterus is the organ for the production of the young from the fertilised ovum. Even prior to fertilisation, the uterus nourishes the ovum discharged by the ovary, till it is fertilised. It allows the fertilised ovum to be grown into fœtus and maintains it in its cavity, until the child is fit for existing separately. When its protection is no more needed, it expels the child as a foreign body. The uterus changes with the development of the foetus. The uterine walls become much thickened and the uterus gets distended to accommodate the growing fœtus. After delivery the uterus returns to its normal size. This reversion to a normal size is called 'involution'.

The uterus passes through a critical stage during parturition. During pregnancy the neck or entrance of the uterus is sealed by an antiseptic ball which prevents the entrance of any bacteria. After parturition, the opening at the neck is many times enlarged. Where a pea could not be forced in conveniently, now allows to pass through it the entire child, so great has been the enlargement. After delivery, therefore, there is the need of great aseptic precautions to prevent the entrance of any bacteria through the enlarged and unprotected opening of the uterus having a raw bleeding surface on account of the detachment of the cotyledons of the placenta. It is not that inflammation of the uterus must appear *after* parturition, it may happen prior to that due to accidents or to abnormal condition of the health

of the foetus in the uterus. Most generally, however, metritis occurs after the birth of the calf.

At this point many things may have happened. In case of difficult labour the opened out mouth of the uterus may have been exposed for a long time to the outside air. Dirty or non-aseptic hands may have been put in to correct the position of the foetus for internal examination or for ensuring delivery. Instruments may have been used to complete the delivery, if necessary, after the dismemberment of the calf. Any one of these things may have happened exposing the uterus to bacterial injury. In the case of delayed placenta, the hand has to be used, when the placenta fails to come out normally. The force of traction on the still attached placenta may set up irritation and inflammation. A portion of the placenta may yet remain attached to the uterine wall or may remain loose and yet remain unexpelled or withdrawn. This foreign body then rots and infects the uterus. These are some of the causes of metritis or the inflammation of the uterus. In some cases when the birth has taken place normally, metritis appears in the course of 7 to 10 days.

Symptoms : The lips of the vulva become sensitive and painful when touched. The membrane lining the vagina becomes reddened and swollen. The temperature rises to 107 or 108°F. Rumination is suppressed. Milk secretion fails or is stopped and the eye becomes blood-shot. The cow does not lie down but prefers to stand, specially when the inflammation is advanced. Discharges flow out of the vulva which

become gradually thick and very offensive. The peritonial wall may be affected giving rise to accumulation of fluid. There are fits, and death takes place in great depression. The disease may be tractable at the earliest stages, but when the symptoms are fully developed and toxication has proceeded far, recovery does not take place.

Treatment : The disease has to be prevented and is preventible with careful handling. There should be strict aseptic conditions prevailing if any occasion for handling or even for internal examination occurs. In case of delayed placenta or non-expulsion of the placenta, manipulation has to be resorted to. The nails must be pared and the hand surgically disinfected before insertion in the interior. Portion of the adhering placenta should gently be detached with the fist with folded fingers so that only a blunt surface is presented to the uterine wall. The last traces of fragments should be brought out. Some are in favour of not irrigating the uterus, for, there is difficulty in withdrawing the fluid which with its irritating antiseptic character has to remain in the uterine cavity till absorption.

When the hand has to be used it is to be followed up by the antiseptic precautionary treatment of giving M. B. 693, 10 tablets each day for 2 days. When, however, infection has set in, the uterus is to be irrigated with antiseptic lotion and every care should be taken to withdraw the liquid from the uterine cavity by syphon action. For this purpose Potassium permanganate 1 : 2000, boiled in water may be used.

After all the water has been drained out, a pessary of boric acid and iodoform should be introduced into each horn of the uterus. This process of washing and draining must be done twice daily or oftner according to the condition. Symptoms should be treated as they occur. The heart should be kept strengthened if necessary by the subcutaneous injection of strychnine $\frac{1}{4}$ grain. Medicines by mouth are not of much use. The bowel, however, should be kept moving by castor oil or magnesium sulphate given by mouth. Treatment with M. B. 693 should be continued for one course. Injection of polyvalent strepto vaccine is recommended.

CHAPTER LV

MINOR SURGICAL METHODS

On dealing with the diseases of the cow one may find oneself under the necessity of performing minor operations to give relief to the animal. Large operations involving technical skill should wait the arrival of a qualified veterinarian or the animal should be sent to the hospital for animals where such hospitals exist,

Boils and abscesses, cuts, blows or accidents, or cases of hernia or tympanitis may occur, which, with a little practice may be attended to without harm and which may give considerable relief to the animal or in certain circumstances save its life.

1474. SURGICAL REQUISITES

In such cases operations of a simple nature should be performed with due aseptic precautions. For such minor operations the following instruments and articles will be necessary :

Knife with a sharp point, Forceps, Director and probe ; Scissors, Artery forceps, Curved and straight surgical needles ; Silk thread, Catheter rubber, Bandages and Douche-can.

The knife should be preferably with a metal handle for easy cleaning. The forceps are like pincers

with lines indented inside for better grip. Probe is a silver or German silver wire with a round point to feel the depth and direction of a wound. On one face of a probe is a groove which is used for directing the

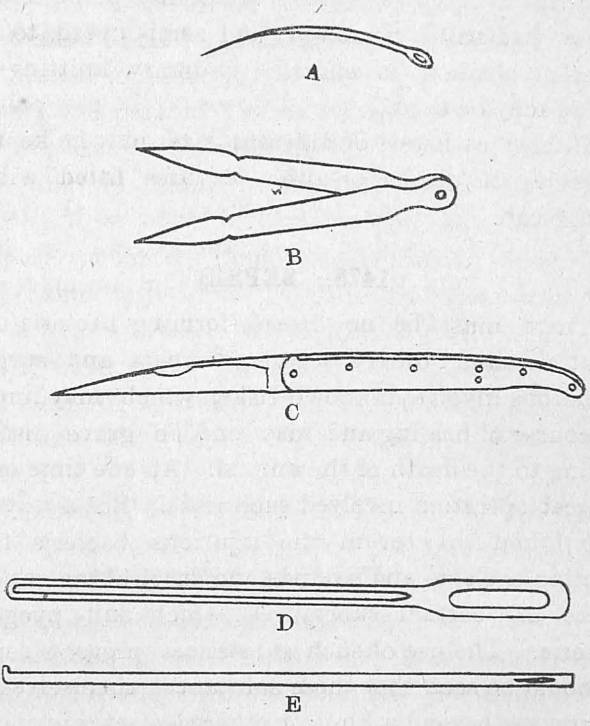


Fig. 129. Surgical instruments.

A. Curved surgical needle ; B. Forceps ;
C. Knife ; D. Director ; E. Probe.

knife point, by which the knife may not depart from a pre-determined path. Surgical scissors are like ordinary scissors which may be cleaned thoroughly.

Artery forceps can be locked after gripping an artery. The artery may be drawn up and twisted and kept gripped to stop bleeding or a ligature may be put on it while under the grip of the forceps.

Surgical needles have a triangular point and are either straight or curved or semi-curved to suit different position of suture. Ordinary knitting silk thread may be used.

Rubber catheters of different sizes may be kept for irrigating the uterus or other cavities fitted with a douche-can.

1475. SEPSIS

There must be no disease-forming bacteria in or about a wound ; otherwise wounds, cuts and surgical operations involve unknown risks, which may impede the course of healing and may end in grave disaster leading to the death of the animal. At one time every surgical operation involved such risks. But a way has been found to prevent the injurious bacteria from affecting the cuts and wounds and surgical operations. There are certain substances which kill pyogenic bacteria. The use of such substances prevent sepsis. It should be seen that these substances themselves do not irritate beyond a limit or otherwise act injuriously. Such substances are called **antiseptics**. Solutions of carbolic acids, mercuric chloride, potash permanganate, thymol, boric acid have all antiseptic properties ; so also tincture of iodine.

Heat is a powerful antiseptic and so is sunlight. Plain water boiled and used just cooled to the point

where it ceases to scald will be a tolerably good antiseptic. Water boiled with *neem* leaves and used as hot as can be tolerated will serve the purpose. As the wound is to be washed with antiseptic lotion, similarly the hands of the operator, the dressings and the skin also should be in an antiseptic condition.

Saturated solution of the boric acid in water or boric acid one part in 5 parts of water may be used for dipping gauzes for cleaning and dressing wounds. Where tincture iodine is available a few drops of it just to lend its odour or tint to the water is good enough to render the hands, instruments, dressings and the skin antiseptic. Iodine irritates wounds. Where a large surface is to be dressed boric solution, 1 in 10 of water, may be used. Boiling *neem* water may be used for sterilising the instruments and hot *neem* lotion may be used for washing hands and the skin.

In operating, hair should be shaved off, the skin and the place rendered sterile by the application of a thin paint of tincture iodine. This is better than moist cleaning with soap and water.

Sterilisation of the dressings such as bandage is of great importance. A steriliser may be improvised and used for this purpose.

1476. STERILISATION AND STERILISER

A steriliser can be improvised out of a flat bottom pan with a lid. The pan may be of brass or of aluminium. It has to be provided with a shelf or wire gauze.

Now take three pieces of wire two inches longer than the diameter of the pan. Fold an inch at each end at right angles. The wires may now be spread out fixed by a wire, looped and passed over each. This is put inside the pan, forming the support of

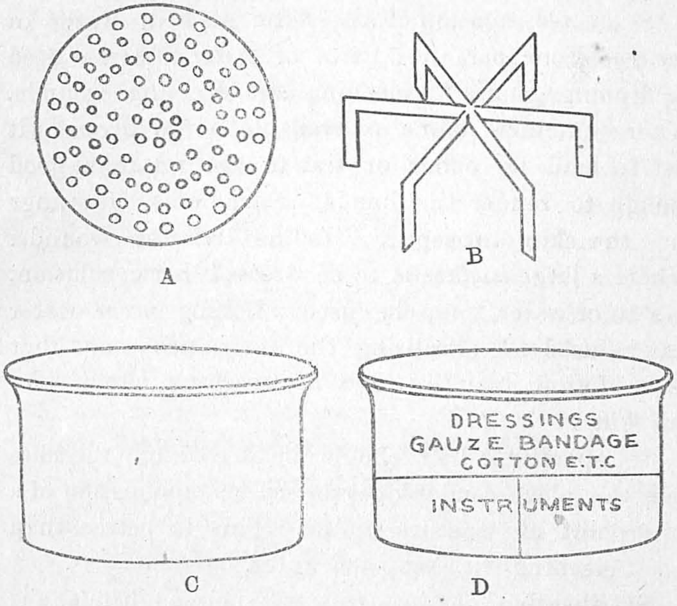


Fig. 130. Steriliser.

A. Shelf of wire gauze ; B. Stand ; C. Pan ; D. Steriliser.

the shelf. The shelf may be a piece of wire gauze cut to a circle or it may be a piece of disc, perforated at intervals. The shelf is put on the support.

If wires and wire gauze are not available strips may be cut from an old aluminium pan. The disc

may be made of the same material, and perforated by punching holes with the point of a nail. The pan, the support, the shelf and the lid complete the steriliser.

Now put the instruments on the bottom of the steriliser, with needle, silk thread etc. and pour some clean water in the pan, enough to cover them and a little more. Then place the stand and the shelf on it. Over the shelf place the bandage, cotton, gauze lint and other dressing materials. Cover the pan and put it on a fire and allow the water to boil briskly.

Add water from time to time to make up for evaporation so that there may be always some water in the pan. Half an hour's brisk boiling and steaming will complete sterilisation.

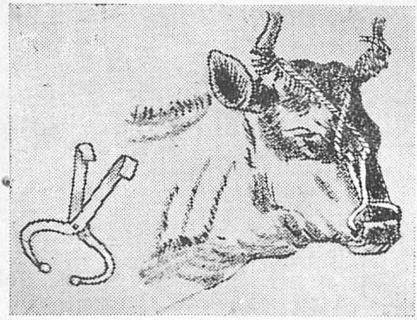
1477. CONTROLLING AN ANIMAL
(RESTRAINT)

An ox may be controlled be putting the thumb and fingers of one hand in the nostrils and gripping, while the other hand grips the horn near its tip, This will give sufficient control for examination or for slight operations.

A bull holder may be used to grip the nostrils and the end ring fastened by ropes to the horns as illustrated. (Fig. 131).

A rope tied round the pastern to hold up a fore foot may be used for the purpose of examination or slight operation.

A rope may be passed round the neck and then through the hollow of the hind pastern. By drawing



A B

Fig. 131. Restraining by bull holder.

A. Bull holder ; B. Bull holder fixed on head.

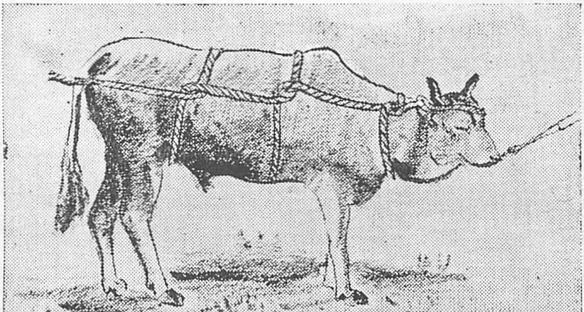


Fig. 132. The loops of rope in roping.

the two ends together the foot is lifted and may be examined with the other hand.

The two hind legs may be fastened as in milking.

Cast position: Animals may be cast in the usual way with the help of a rope and two persons as is done in the case of shoeing them. There are people who can cast a large animal in a few seconds. The skill lies in casting a heavy animal without injury. Careless casting may result in the fracture of one of the leg bones. This accident sometimes happens and every care should be taken to prevent it.

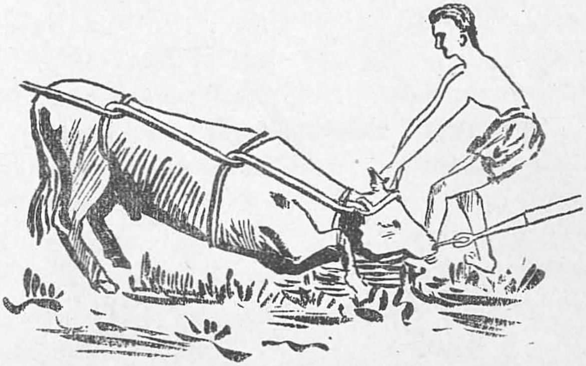


Fig. 133. Roping.

After roping, the cow gently goes down pulled and pressed by a single man.

1. Take a rope 40 or 50 ft. in length. Fix one end of the rope round the base of the horns. Then make a series of loops one round the base of the neck, another round the anterior part of the trunk and a third round its posterior part. (Fig. 132). Tighten all the loops and then pull hard on the front end of the loop. The animal will gradually sink to the ground. (Fig. 133). When the animal is down, tie the limbs

together by a rope. The rope may slip and cause injury to the penis or the mammary gland. There is this risk in this method.

2. Take a rope 40 to 50 ft. long. Apply its middle to the middle of the body in front of the withers. Cross the two parts of the rope in front of the dewlap. Pass them between the forelimbs in front

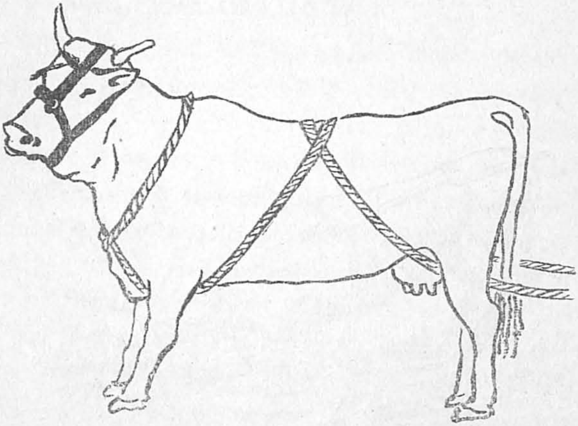


Fig. 134. Roping without injury to the udder.

and then over the sides and back where they are crossed again and passed between the thighs. By applying traction on the ropes the animal will fall very slowly and with ease. (Fig. 134).

1478. ANÆSTHESIA

Anæsthesia may be local or general. For general anæsthesia the inhalation of chloroform is the best for the ox. But cases which require general anæsthesia

by chloroform for surgical operations should be left for the qualified surgeon to do. We are concerned with cases requiring local anæsthesia or cases in which a general hypnotic effect is needed. Cases of prolapses of the vagina, the uterus or the rectum or of hernia or dystokia require more intense anæsthesia. This can be secured by having recourse to epidural anæsthesia.

1479. LOCAL ANAESTHESIA

Local anæsthesia may be brought about by the application of cold. This can be done by applying crushed **ice and salt** in an ice bag over the region. Better and deeper anæsthesia may be brought about by spraying **ethyl choloride** over the surface. Many operations may be done painlessly by the local use of ethyl chloride. Ethyl chloride is sold in tubes with spray nozzles. Its effect does not last long and is useful only when the work can be finished in a few minutes. The vapour of ethyl chloride may explode in contact with fire.

Cocaine is the most reliable local anæsthetic. Cocaine hydrochloride is most frequently used in solution of 1 per cent. This strength gives generally the desired effect, but a 4 per cent solution is generally employed being more reliable.

Cocaine hydrochlor	...	1½ grains
Mercury perchloride	...	·03 grains
Water ...	...	2½ drams.

The addition of perchloride of mercury in the minutest proportion gives keeping quality to the

solution. It is frequentiy injected subcutaneously when it acts on the tissues as well on the skin. Injection at intervals of about 1½ inches along the line of incision is the common procedure. By rubbing on the spot a mixture of carbolic acid 1 part and camphor 4 parts the skin is made insensitive to the puncture of the needle. For an ox no more than 3 grains of cocaine should be used at any one time. Usually 1½ grains ought to be quite enough. Cocaine is toxic in larger doses. The action of cocaine is hastened and its toxicity diminished by the simultaneous injection of adrenalin.

Chloral Hydrate: For bringing in stupor or a general hypnotic effect the administration of chloral hydrate by mouth is very useful. It may be given also by the rectum.

Chloral hydrate is irritating and must be well diluted with gruel and drenched or introduced through the rectum. Giving some solid food after its administration by the mouth enhances its effects. The dose is 1 to 2 ounces of chloral hydrate dissolved in thick gruel and made up to 8 to 16 ounces. The solution may be introduced through a stomach tube or by drenching.

These amounts render the animal to come easily under control. Chloral hydrate may be combined with the use of local anæsthetic when prolapses of organs or reduction of hernia may be attended to.

1480. EPIDURAL ANÆSTHESIA

The method of anæsthesia is widely practised in the cattle. It is done by injecting a local anæsthetic

solution into the epidural space at the termination of the spinal cord. This method of anæsthetising is specially useful in rendering the hinder part and the abdominal region insensitive. It can be employed for reduction of prolapsed vagina or rectum or uterus.

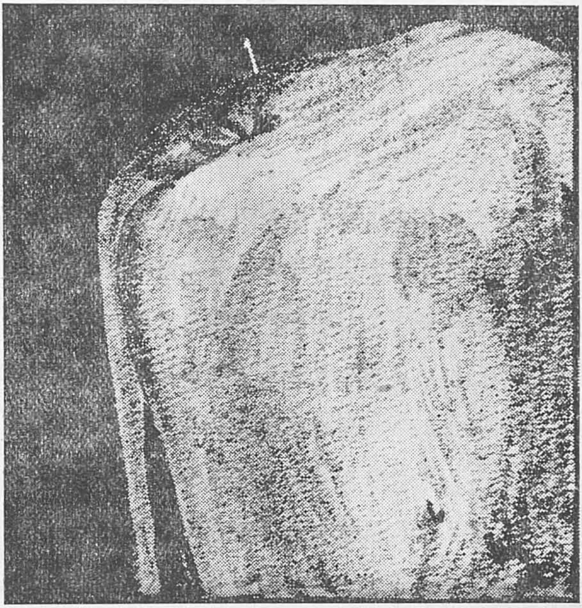


Fig. 135. Epidural anaesthesia.
Arrow mark shows position of injection.

It is equally useful for a thorough examination of the genital organs in the female, for uterine irrigation and for correction of dystokias. In males, the effect of it is the protrusion of penis from the sheath. The penis may then be examined and operated upon if necessary.

The site of injection is between the first and second coccygeal vertebræ. For locating this, the tail should be held horizontally in a line with the median aspect of the body. By moving it up and down the sacro-coccygeal junction will be apparent, being the point where the movement ceases. The site is immediately behind the first coccygeal spine. (See Figs. 135-'36). There is a prominent depression between the first and second coccygeal spine. The

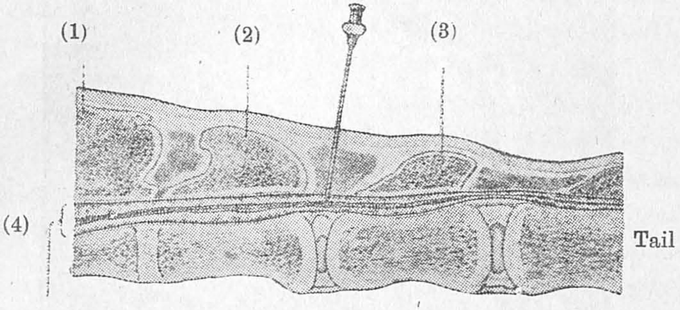


Fig. 136. Site of injection for epidural anaesthesia.

1. Sacral vertebra ; 2. First coccygeal vertebra ; 3. Second coccygeal vertebra ; 4. Spinal canal.

point of depression is chosen at the very middle of it. The needle should go straight at right angles to the vertebra. Any deviation will interfere with the process. For injection a 20 c.c. syringe is to be chosen.

Anaesthesia may be induced either in the standing or recumbent position. In case where the animal is standing 10 to 20 c.c. of 1 per cent sterile solution of novocain per 600 to 1000 lbs. of body weight, is

injected. In the recumbent position for delivery 30 to 50 c.c. of the same solution is to be injected.

Before introduction of the needle the surface is to be clipped, shaved and disinfected. The needle should be 2½ to 3 inches long inserted in the centre of the intervertebral depression as far as the vertebral canal which is ¾ inch to 1½ inches below. To determine that the end of the needle is in the canal, a little of the fluid should be injected, if it flows readily under slight pressure, the position of the needle is correct. But if force is necessary, the canal has not been entered and the needle must be withdrawn and its site or direction altered.

The injection should be made slowly and after pauses.

In all serious cases of calls for difficult labour the use of chloral hydrate by mouth and epidural anaesthesia may be taken as routine programme.

1481. SUTURE

Suture is a very necessary operation for treating wounds. The surface of the wound must be brought together to quicken the process of healing. For stitching wounds a stock of surgical needles should be kept in soft paraffin. They may be straight or curved. The difference between an ordinary sewing needle and surgical needle is in the needle point. The surgical point is triangular and the needle cuts the skin through. An ordinary needle when passed through skin and muscle will fail to take the thread through with it as the skin and muscle will

offer resistance. In a surgical needle, the puncture is not through a point but it is a cut. When a surgical needle is not available, the point of ordinary needle may be flattened and sharpened to make it serve the purpose of a straight surgical needle in an emergency. For sewing work silk thread is the best. Sizes 0, 1, 3 and 6 are suitable for most cases.

Silk thread is strong, non-irritant, and can be sterilised by boiling. Silk is absorbent and is therefore, able to carry a septic liquid through it into

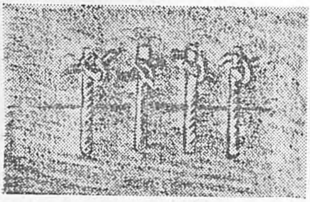


Fig. 137.
Interrupted suture.

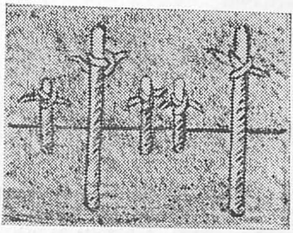


Fig. 138.
Tension suture.

the sutures from the surface and this is a disadvantage. In buried sutures it may remain indefinitely. Sterilised oil or paraffin put as a coat after suturing may reduce the absorbing tendency of the thread used for surface suturing.

Cutaneous sutures : In these there is not much tension. They may be inserted $\frac{3}{8}$th inch from the margin of the wound.

Interrupted sutures : The most commonly used style of suture is interrupted suture in which each

suture is separate. The edges are brought together and caught with a dressing forcep, held tight and the needle passed through. The thread is cut and tied with a non-slipping reef knot. (See Fig. 137).

Relaxation or tension sutures : It is employed where there is a tension between the two edges tending to separate them and great force is exerted for tearing off the suture. In this case, double sutures are employed. One set goes deep through the muscle and is made with thicker silk. These take the tension. Then close sutures are made interruptedly. (See Fig. 138).

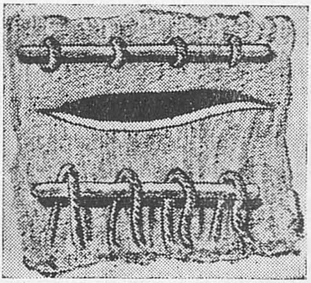


Fig. 139. Quill suture.

Quill sutures : Sometimes a rubber tube is put on either side of the edges and double threads in a loop are passed embracing the rubber tube on the surface, which is called a **quill**. By these means pressure is distributed all along the surface and thereby prevents the threads from cutting through too soon. A piece of clean, rounded rod may be used as the quill. (See Fig. 139).

Suture is suitable when other conditions of healing by first intention which means healing without suppuration prevail. In cases where a plug is to be kept in a deep wound, suture is of use. Otherwise, there is little or no advantages in the suturing of wounds. When major surgical operations are performed, such as opening the abdominal cavity, suturing must be done.

When healing by second intention is about to take place, there is no advantage in bringing together the edges by artificial means. It has no effect in hastening the healing process. When the tension on the threads is great, it does more harm than good.

Suturing a septic wound is dangerous, for, by preventing the escape of septic discharge and by excluding the purifying effect of the air and the sun and promoting the development of anaerobic bacteria, suturing brings about complications.

CHAPTER LVI

DISEASES REQUIRING SURGICAL AID

1482. AFFECTIONS OF THE SKIN

Horny growths : These appear chiefly on the head, also on the back, flank, abdominal wall and limbs. They may be rough or smooth on the surface. In some cases they fall off and reappear or they may remain permanently. The remedy lies in excising off the piece with the skin, the operation being conducted under local anaesthesia. If the outer growth is excised leaving the skin, then a new growth appears.

Warts or papillomata : These are benign growths but when numerous in the form of clusters and stiuated in regions exposed to injury, they may become inflammed and bleed or secrete purulent material. When they appear between the thighs they may be ulcerated and painful. These fall in the class of tumours and the treatment consists in removing them. If they are pedunculated, they may be removed by gradually tightening ligatures of silk thread. They may be removed with the skin at the root with a knife. Or they may be crushed with an ecraseur.

1483. AFFECTION OF THE BONE : FRACTURE

Fracture of bones may be of various kinds. When the skin is not broken it is called **simple** fracture, and when the skin is broken it is called **compound**

fracture. Compound fracture exposes the muscles and bone to the action of outside bacteria and are, therefore, more difficult to tackle. The bone may be broken at a single place or the bone may be in bits when it is called **comminuted** or multiple fracture. The ends of bones may remain in their places or they may overlap, forming a **riding** fracture. The fragments may be displaced or bent at various angles giving rise to complications.

Healing of fractures : Nature always tries to heal the fracture by connecting the fractured pieces by new growths of connective tissues which gradually harden into bone.

Handling : Care should be taken to see that no further injury occurs during the removal of the animal or during the examination. Before removal, rough splints should be put after proper padding and bandaged.

Displacement : There is generally a displacement of the fractured bones. To effect reduction of the bones, the locality should be protected by being made immovable by splint. The animal should be cast. It is advisable to apply hypnotics, so that the animal might be cast without struggling. After that, the bones may be set by extension, by traction or by local manipulation. When the bones are placed in position, an immobilising dressing with the help of splints should be put on. Bandages can be set with the help of plaster of paris. It is advisable to protect the soft tissues from injury by first laying an even layer of cotton wool and wadding. Then the bandage is

immersed in water and air is squeezed out. The bandage is then impregnated with plaster of paris and applied. It sets in a few minutes. In this case splints are not necessary. Care should be taken to see that the hard bandage does not slip down. The lower portion should have some stay to prevent slipping when the bandage has to be applied above the knee joint.

Compound fractures : In bad cases the limb may have to be separated. But in ordinary cases where the tissues are divided without much contusion, there are chances of recovery, although the task is difficult in case of large animals. The wound should be attended to and the fracture reduced as usual. After removing small pieces of loose bone and after cutting off of the projecting points, an immobilising dressing is to be applied with a window opposite the wound to enable it to be watched and to receive necessary treatment.

If the wound is kept thoroughly disinfected, sloughing of damaged tissues occurs without any complication, leaving a granulating wound.

1484. AFFECTIONS OF THE JOINTS

Sprains

Sprain occurs by forced movement of joint beyond the physiological limits. The articular tissues suffer an amount of bruising or laceration. A sprain may occur by slipping, falling or by a false step or by over-strain. Ligaments may be more or less seriously injured. They may even be torn away from their

insertions, and in still graver cases the tendons over joints may be over-stretched and ruptured.

Due to extravasation of blood and inflammatory exudate, there is quick swelling. In cases of slight injury, the recovery may be complete, while in very severe cases there may be permanent lameness.

Treatment is to be for acute aseptic inflammation, which consists of immobilisation of the joint. Cold and astringent applications shoud be followed by hot moist applications and rubifacient massage.

During convalescence regular exercise should be given to prevent adhesions to form.

Dislocation

A joint is dislocated when the two articular extremities are displaced from perfect contact with one another. The dislocation may be due to injury. But it may be due to some pathological condition such as paralysis or it may be congenital. In the two latter cases nothing can be done.

In dislocation there is an obvious deformity due to displacement. When there is severe inflammation and swelling, the tendency is for the dislocation to be concealed. The limb may be shortened or lengthened. A fracture and a dislocation may co-exist. Careful diagnosis is necessary to discover the faults.

Treatment : The dislocation is to be reduced and the limbs brought back to their normal position. The next step is to retain the joint in the reduced position. Retention is accomplished by the use of

slings or by immobilising the joint as in the case of fractures.

At convalescence, the joint should be lightly exercised to promote freedom of articular movement.

1485. WOUND

A **wound** is a break in the continuity of the surface or internal structure in any part of the body made by cutting, tearing or pressure. Wounds may be slight requiring little attention, and wounds may be serious and may be inflicted by sharp or blunt instruments.

When only the surface layer of the skin is taken off by a fall or blow or friction, it is called **abrasion.** When a sharp instrument gets into the body for some distance beyond the skin, it is called an **incised wound,** Injury from a blunt instrument results in a **lacerated wound.** the edges of which are irregularly torn. A sharp blow or severe pressure may look like an incised wound but on careful examination lacerated edges of the skin will be found. A **contused wound** is a variety of lacerated wound in which the injury is greater inside, the surface often having suffered little bleeding. A stab causes a **punctured wound.** Internal structures or deep-seated arteries and nerves are likely to be involved. These wounds are dangerous.

What has been said of fractures is also true about wounds. Nature sets about repairing the injury immediately after. If a healthy person's skin is sterilised and then a cut made and then bandaged with aseptic precaution, the cut ends coming together,

then the process of repair begins immediately and the wound would heal without suppuration. This is the natural process. From either side of the cut edge a white substance exudes joining at the breach. Through this line repair goes on by formation of new tissues which interweave with the opposite faces. If the wound is separated at this stage it will be seen that the white exudation has got new blood in it and that the process of repair has proceeded far. If after some more time the wounded edges are again separated it will be seen that there is simply a white line where the cut was. After further lapse of time this line may also be absorbed and mây disappear, If the skin is not made sterile but if the cut edges are put together side by side, still a wound may heal without suppuration. This is called **healing by first intention.** But if pus-forming bacteria find entrance or if the edges are not joined up, such a healing by first intention is not possible. Yet it must be said that in cases of healing by first intention, it is not a fact that pus-forming bacteria are entirely absent. They are there, but their number is few and they get swallowed by the leucocytes which rush to the site. The condition of purity of blood and general health also are great factors. In debilitated condition even inspite of placing the edges of wound side by side in aseptic contact and under aseptic surroundings, pus will form.

Wounds not healing by the first intention are said to heal **by second intention.** There are grades here. Healing may be attended with a small amount of

ulceration or with marked inflammation and ulceration or suppuration.

When the edges can be brought together and the cut surfaces close up, the wound needs simply be dressed with boric acid dusted over or by putting a piece of sterile cotton soaked in saturated 20% solution of boric acid and wrung out. The piece of cotton is to be kept in place by a bandage. When there is dirt inside, the wound should be washed out and bleeding stopped. If the gap is so situated or so deep or wide that simple pressure cannot close it up, the edges should be stitched. Muscles in the interior may have to be stitched to facilitate contact between the surfaces. After this is done and the surfaces brought together, the wound should be covered up with borated cotton and bandaged. When, however, there is so much loss of substance that even a suture is not of use, then the gap should be filled up with a plug of gauze dipped in warm boric lotion and wrung out and then bandaged.

In such a case the inflammatory exudation which quickly ensues, gets taken up and absorbed by the gauze and prevented from decomposing which would otherwise happen. Herein lies the utility of filling wounds with gauze. After this there is only a limited amount of ulceration of the surface and of surrounding inflammation. There is a little thin reddish discharge and when the gauze is raised, a glazed surface is exposed. The wound is covered up with small red elevations called granulations which fill up the wound gradually. The surfaces get filled up and the edges

get united by this process with the formation of an amount of fibrous tissue and some contraction and a scar will be left.

If, however, the wound does not so heal because of the severity, extent and inflammation already set up before dressing, then there will be acute inflammation extending to some distance and profuse discharge of pus. After dressing with antiseptic gauze the wound may proceed from bad to worse, create sepsis resulting in septic intoxication or hectic fever. On the other hand, it may not advance so far. The sloughs formed may separate, the quantity of pus may gradually diminish and the surface gets covered with red granulation which is a sign of healing.

In using antiseptics, the stronger ones such as carbolic lotion or iodine, if not dilute d very greatly, may be a source of irritation and preven t healing by first intention or delay healing by second intention. Boric acid is a weak antiseptic but it is practically non-irritant. With scrupulous care about washing, cleaning and bandaging, boric acid may help healing quickly. But iodine has to be applied on dirty and exposed wounds to prevant tetanus and other grave septic issues. Very dilute iodine solution giving only a tint to water should be used for dressing. Where iodine and boric acid are not available, hot *neem* water should be freely used.

In dealing with a wound the first thing is to stop bleeding. Next, the shock should be attended to by soothing the animal either by local anaesthesia or by the hypnotic action of chloral hydrate.

1486. ULCER

Ulcer is a new or old superficial wound involving destruction of tissue, showing little tendency to heal. It may be caused by constant irritation in a wound or there may be certain bacterial conditions preventing healing. It may be due to deficiency of blood supply to the affected part involving the wound. The ulcers may be due to specific causes such as tuberculosis. It is more or less a rounded breach of the surface. The centre may be hard or soft, flat or concave.

Treatment : Treatment consists in removal of the cause. The part should be immobilised as far as possible. If there is a tendency to scratch, this should be prevented. Warm antiseptic fomentations should be applied. When the ulcer is disinfected a moderate pressure of cotton pad under bandage may promote healing. Dressing with iodoform may be helpful.

When the cause of trouble has been arrested and the granulations are excesslve or unhealthy, the surface may be treated with a caustic or an astringent application like copper sulphate in dilute solution. For small ulcers an operable regional excision with a knife is the best treatment.

Bier's Method is to cause venous congestion in the affected part by the application of a bandage at the proximal end of a limb or appendage sufficiently tight to arrest venous circulation but allow arterial circulation. A stout bandage may be rolled round the limb. The band should never be tight enough to cause pain and must be slack enough to allow a finger to pass under it. As a result of the pressure of the

bandage the part below its point of application should become oedematous and warmer than normal. If, however, the bandage is too tight, the animal feels pain, becomes restless, sweats and the part becomes cold. This should never be allowed to happen.

The duration of the compression varies from 4 to 6 hours daily. The time should be shortened with the progress of the process of healing. In regions where a ligature cannot be applied, cupping may be taken recourse to. It should not be applied for more then 10 minutes at a time.

Septic ulcers show remarkable improvement under this treatment. For ulcers due to specific diseases specific remedies should be used. Another way is to help nature to heal an ulcer by forced congestion, by moist heat or counter irritation.

1487. ABSCESSES

Abscesses may be hot or acute, cold or chronic. They may be superficial or deep-seated and they may take a general character.

Acute abscess forms after a period of 3 to 5 days from the commencement of infection. There is a covering wall and the contained substance is pus. When pus is retained a long time, its liquid portion undergoes absorption while the solid becomes caseated and after a time becomes calcified. The wall is formed of inflammed tissues which gradually become soft till the abscess bursts. If pus can not escape on account of the presence of a resisting tissue such as the hoof, the abscess extends in the

direction of least resistance until it finds a means of escape.

Superficial abscess appears as an inflammatory swelling. The centre of swelling becomes gradually soft. Fluctuation can be detected by pressure with the fingers. If left to itself the centre becomes thin and the abscess is said to be pointing. It soon afterwards bursts allowing pus to escape.

Treatment consists of measures for helping the maturation of the abscess, and when it is mature, the abscess has to be opened out to evacuate the contents.

For maturing an abscess, fomentation or application of hot poultice is helpful. Where there is chance of absorption, fomentation helps that. Otherwise suppuration is induced, When the part shows fluctuation on pressure, it indicates pus formation.

The abscess is then to be operated upon by an incision, after taking antiseptic precautions. The incision should be along the length of the muscle or across if it is a pit or joint. If arteries are cut bleeding should be stopped by clinching the artery with an artery forcep. Symes' abscess lancet is to be used.

For operation, hold the knife with its cutting edge upwards and push the point through the elevated and soft portion of the abscess. The point of knife will pass through the swelling to the opposite edge of the abscess. Now pull the knife through connecting the two points by incision, Clean out pus with a swab. Put some sterile boric gauze by dipping a cut piece of bandage in hot boric lotion and squeezing

out. Close the wound by a bandage. The wound should be bandaged daily. When the wound is healing, plugging with gauze will not be necessary.

In opening abscesses where there are many blood vesseles as in joints of limbs, one is to be sure about the presence of pus before operating. The opening should be made along the fold of the skin. The

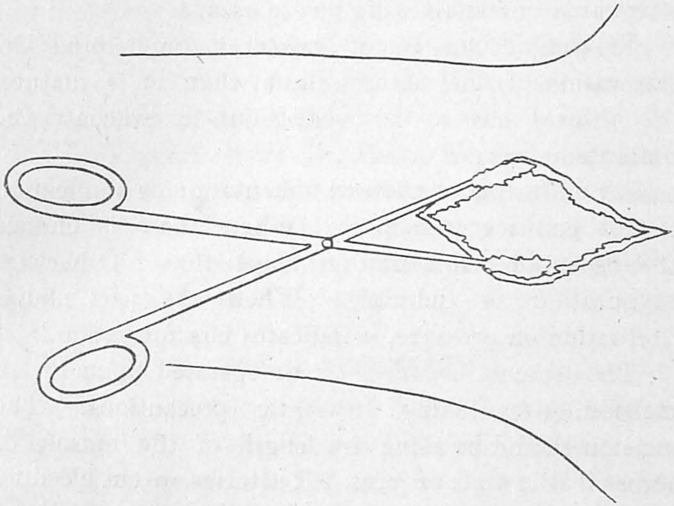


Fig. 140. A dressing forceps with a piece of cotton wool or gauze for widening incision.

opening should not be made very deep as it may injure inner vessels. The opening may be made bigger by pushing in a dressing forcep padded at the points with cotton wool, and the handles then separated out. This causes the opening to be wider.

Gangrene: Gangrene is an ulcer manifested by death of the part already affected. **Dry gangrene** is

marked by the part affected assuming a pale and white appearance, mottled with brown here and there. Generally it exhibits same changes as are seen after death in body. The skin is cold. When a cut is made into the limb it is seen to be bloodless for which it generally mummifies. Soon the skin shrivels and is converted into a black mass which is separated from healthy tissues by ulceration. It has a musty odour. **In moist gangrene** the limbs are distended with venous blood. It is inflamed at first. A peculiar burning sensation is felt just before the circulation ceases. Gradually the limb becomes cold and putrefaction commences. The hœmoglobin diffuses and the limb undergoes some change in colour from red to brown ultimately to green and blackish green. A foul odour of decomposition becomes evident. The skin becomes slimy and separates on touching. The causation of gangrene is due to partial or complete failure of flow of blood through the affected part.

Treatmet lies in excision of the affected part. Care should be taken to see that the gangrene does not spread. For this purpose the borders of the wound should receive hot compress.

1488. PROLAPSES

Prolapses of the **rectum** either simple or with or without invagination of a portion of the colon may occur.

The treatment lies in making the animal relax. This can be brought about by epidural anaesthesia or in minor cases by the use of chloral hydrate combined

with local anaesthetic application. The animal may be kept standing or better in a reclining position with the hind portion raised.

In simple prolapses, reduction can be effected by slow continuous pressure, from outside. But when there is in-vagination, dexterous manipulation is necessary. Merely pulling or pushing the mucous membrane may tear it. If the intestine has entered the fold, it has to be pushed out by slow pressure along the tube inside the rectum. If the prolapse is of a long duration, it may be difficult to reduce it and keep it retained. Application of cold or warmth may help reduction. Otherwise expert surgical aid is to be taken.

Prolapse of the **uterus** may occur after parturition in cows. It is always dangerous, for the animal may injure this delicate organ by rolling on the ground in pain. The animal should be given chloral hydrate or better epidural anæsthesia should be brought about. The relaxed animal will now allow the part to be examined. If there is dirt etc. take up the organ in a bowl of water at blood heat and wash out all foreign matter. If there are cuts and if suture is necessary, put in necessary stitches. Then attempt reduction by putting a sterile towel over the organ and pushing it slowly in the vagina. It should be remembered that the uterus is rather of a brittle structure and the handling should be delicate.

1489. HERNIA

Hernia is the protrusion of some enclosed organ from its normal position. Hernia may be umbilical

or inguinal. Hernia gives rise to a soft elastic swelling of the part in which it protrudes. In cows sometimes the protrusion of hernia occurs by the edge of the vagina on one side.

Treatment : As in the case of prolapses, treatment consists in reducing the protrusion to its normal place. This can be done by relaxing the animal under epidural anæsthesia or by dosing with chloral hydrate and by application of local anæsthetic. When the relaxation is full, the part is to be gradually pushed in under slow and constant pressure.

In cases of hernia the animal should be given purgative so that the stool may be softened, which will also help retention. In severe cases surgical aid is to be obtained.

CHAPTER LVII

DIFFICULT LABOUR : DYSTOKIA

1490. DIFFICULT PARTURITION

Dystokia or difficult birth is a subject of great importance to the owners of cows. The cows are more liable to develop cases of abnormality in parturition than many other domestic animals, for example, it is said that for every one case of dystokia in the mare there are at least two cases in the cow. The cow presents, however, an advantage over the mare in the matter of abnormal parturition. The cow being of a quiet and phlegmatic disposition, bears through a difficult parturition much better than the mare. The mare is quick, excitable, impatient and tempestuous in parturition. So that in abnormal parturition the mare is most likely to injure herself, rupture the uterus or bring some other serious injury or death to herself and the foal. The cow, however, is patient and long suffering and, therefore, is amenable to treatment and allows manipulation better, resulting in a very large number of successful handling in difficult situations. In the case of the mare the duration of life of the foal in abnormal labour does not exceed the fourth hour, whereas in abnormal labour in the cow the calf lives for 6 to 8 hours.

But even with this patient animal, the cow, we are not able to do what we should do in abnormal labour. By a little scientific handling, use of anæsthetics and by the careful use of the hand for manipulation and traction or repulsion, much could be done. In difficult labour the aid of the veterinarian is rarely received, and even when a veterinarian is called in, he often finds the case past all help because of the treatment to which the cow and the calf have been put by unskilled men in their attempts to give relief.

With the possession of a fair amount of general knowledge about obstetrics a man can, however, do a very great deal with the help of some of the most simple appliances like some lengths of cords, hooks, a fork-like crutch or repeller, a pen knife etc. which are to be kept ready for emergency, and capable of being cleaned and sterilised readily.

1491. THE CLASSIFICATION OF DYSTOKIAS

Dystokia may be due to—

A. **Defects in the mother**, such as constricted pelvis, displacement of the uterus or other alterations, misplacement of the umbilical cord etc. ;

B. **Defects in the fœtus**, such as excessive size, malformations, monostrosities, diseases and multiparity ;

C. **Defect of abnormality in presentations**, which are classified as **anterior**, **posterior**, and **transverse**. In each of these presentations, the fœtus may take up various positions, offering greater or lesser degrees of difficulty in the same presentation.

The different aspects of difficult labour are treated serially in the following pages and indications are given as to how to deal with the situation that may have arisen.

1492. EXAMINATION OF THE ANIMAL FOR DYSTOKIA

The veterinarian on arrival should gather all the available information at once. He should enquire about the following in particular :

(1) The time of commencement of the labour pain ;
(2) If the water bag has ruptured and if so how long ago ;
(3) Whether it is a primipara, if not, if its previous parturitions were normal.

The veterinarian should then proceed to examine the animal. His hand and arm should be first bathed in an antiseptic lotion and the back of the hand and the arm should be lubricated with carbolised oil or carbolised vaseline or lysol soap solution. This will serve the double purpose of protecting the hand of the operator from infection and also of lubricating it. The cow should be examined in a standing position, if possible ; the cow being firmly held at its head to keep it quiet. A foot may be raised or the hind legs may be hobbled to prevent kicking. It will be helpful if the rectum and bladder are emptied before an examination.

1493. (A) MATERNAL DEFECTS : UTERINE DYSTOKIA

If the vagina is empty the operator should determine if there is any abnormality in it with its relation to the uterus, and also measure by guess whether the opening of the pelvis is normal or constricted or otherwise obstructed by extraneous growth. If the fœtus is already in the passage he will be able to find out if there is any deformity in the calf. He will try to ascertain in case of delayed birth if the uterus is under torsion or if there is uterine hernia. Hernia is, however, visible from outside inspection prior to internal examination.

In case he finds that the passage is too narrow in the pelvis either due to its construction or due to abnormal largeness or monstrosity of the calf, he will have to decide whether it will be possible to squeeze out the fœtus through traction or whether an embryotomy will be necessary for taking out the fœtus.

In case of **torsion of the uterus** the hand may be pushed far into the neck of the uterus to determine the direction of torsion. The rolling of the cow on itself in one direction or another is a positive method of correcting the torsion by keeping the hand inside the neck of the uterus while assistants roll the cow. If by rolling in one direction there is more torsion, then the rolling should be given in the opposite direction till the torsion is rectified. This simple process saves the life of the animal in most cases. But if the torsion cannot be rectified, then the fœtus remains in the closed end bag—the uterus, and both mother and the

fœtus die. The torsion of the uterus is a very serious accident although by judicious and timely intervention both mother and the calf may be saved.

If there is hernia of uterus, a wide piece of folded cloth is to be passed under the abdomen and pulled up on the back. Most generally this allows the neck of the uterus to come in line with the vagina, when normal delivery takes place.

Another defect in uterus may render labour difficult. The neck of the uterus may be too stiff to be opened by the force of pain exerted by the water bag. Here nature mostly rectifies the obstacle. The labour may continue for 2 or 3 days, when after all the os submits to pressure and begins to dilate.

When, however, there is prolonged and energetic pain for 5 or 6 hours and there is no opening of the os (mouth of the uterus), then intervention is necessary. The cow should be given chloral hydrate by the mouth for relaxation. Blankets wrung out of hot water should be placed on the back every 10 minutes. One dram of green **extract of belladonna** should be smeared near the cervix or introduced within the os to dilate it. Chloral hydrate relieves distress without interfering with the natural periodic contractions of the labour pain. Belladonna prevents spasm of the os and permits dilatation. If this is not successful, local application of an anæsthetic may serve the purpose. If even this fails, then the fingers may be introduced in the form of a cone. If the opening is not large enough to admit this cone, then a single finger may be introduced and worked up so as to allow another

finger to pass and so on till the hand may be pushed through. This operation may require a long time and great patience. Mechanical dilation may be effected by introducing a uterine dilator in which water pumped gradually from outside causes the rubber bag to dilate, which consequently dilates the os. By injection of warm water from a douch the dilatation of the os (opening) may be induced.

1494. (B) DEFECTS IN THE FŒTUS : FŒTAL DYSTOKIA

The internal examination may have revealed that there was nothing wrong with the pelvis, the genital passage or the uterus, but that the difficulty is due to the fœtus. Here again the obstruction may be independent of the presentation of the fœtus and may be due to defects in the calf itself.

Dystokia due to defects in the calf : The calf may have got the umbilical cord noosed round one of the parts of the body of the fœtus which created obstruction to its free passage. In this case, a more careful examination will show where exactly the flaw lies. This fault may be readily rectified by manipulation.

The difficulty may be due to the calf being too big for the organs. The way to combat this difficulty is to lubricate the passage and apply mechanical force on the fœtus for traction or effect repulsion, correction aud traction. When all these fail, the way to meet the difficulty is to have recourse to embryotomy as the last step.

The calf may have hydrocephalus or possess too big a head. The calf may be a monster having distorted, exaggerated or misplaced limbs. There may be more than one calf in the womb and the two calves may have inextricably intertwined their limbs. In all such cases, attempts should be made to manipulate the fœtus in such a way that delivery may be effected with or without mechanical aid.

Occasionally it happens that impregnation of a small cow by a bull with large formation of head creates difficulty. The size of the calf at birth mostly depends on the size of the mother, Some, however, are of opinion that the mother contributes sixty-six per cent to shaping the size of the calf. Whatever that be, the peculiarity of any part of the bull is sure to affect the formation of the calf, and when the head of the sire is very big, there may be danger at the time of delivery. (1042, Vol. I)

1495. (C) DYSTOKIA DUE TO ABNORMAL PRESENTATION

Normally the calf presents itself at the pelvic inlet with its body parallel to the body of its mother, the head facing the pelvis and the two fore limbs protruding out. In normal labour the fœtus, after it has broken through the water bag, is pushed towards the pelvis. After a time, as the uterus begins to constrict and force out the contents, the two fore-limbs make their appearance at the vagina. Then appears the muzzle and then gradually the whole elongated body slips out.

The calf may be presented in the wrong way. And there may be a number of ways in which the calf comes to be presented in abnormal cases and create difficulty.

The calf may present itself to the pelvis with its long axis parallel to the long axis of the body or it may present itself transversely. In the first case, the body may be presented from either ends. In other words, the presentation may be (1) **anterior** when the anterior portion of the body enters the pelvis first, or it may be (2) **posterior** in which the posterior extremity of the body of the fœtus is directed towards the pelvic inlet. The third case of (3) **transverse** presentation may be (a) **dorsal** or dorso-lumbar in which a portion of the dorsal aspect of the body is presented or it may be (b) **ventral** or sterno-abdominal in which the ventral aspect of the body with some of the limbs is dircted towards the pelvis.

1496. C.(1) ANTERIOR PRESENTATION

(a) Wedging in of the Stifles.

In the anterior presentation the extended head and the fore-limbs are towards the pelvic opening.

On internal examination, it may be found that the anterior portion is normal and the fore feet and the head have emerged out ; but the hind limbs when extended may present a pair of stifles which are so voluminous that even when the flanks and the trunks have cleared the vulva and the act of parturition is almost complete there comes a dead stop and the fœtus fails to come out naturally. The obstacle may

prove to be a serious one and mere traction may help to jam the fœtus with the pelvis. In that position the calf is lost and sometimes the mother also.

Attempts should be made first to repel the fœtus and manipulate the stifles by the hand so that they may be presented obliquely and thus pass through the pelvis by oblique traction.

As a last resort, embryotomy has to be performed.

1497. C.(1) ANTERIOR PRESENTATION

(b) Hind limbs folded under the body and entering the genital canal with it.

This is an uncommon mal-presentation and one of the most difficult presentations. The body becomes bent at the loins and the hind limbs advance into the pelvic canal with the head and fore limbs, and gets wedged.

At first nothing appears to be wrong. The head comes out of the vulva and then there is a stoppage. No further progress is possible, and the more the force of expulsion is applied by the uterus, the more wedged the fœtus becomes. Traction can only worsen the situation by tightening the calf more and more within the grip of the pelvic canal.

On examination by introducing the hand the veterinarian may feel one or both the hind feet in the pelvis. But it is rarely that the hand can be introduced when there has been a jamming. Traction in this situation will kill both the calf and the mother.

The calf should be pushed back to the uterus and the hind limbs pushed out from position one after another. A repeller has to be used. The calf generally

perishes and embryotomy may have to be used on most occasions.

1498. C.(1) ANTERIOR PRESENTATION

(c) Fore limbs crossed over the neck.

Generally one limb is found carried over the neck, but both the limbs may be so placed, though rarely. In this position with violent labour pains the limbs

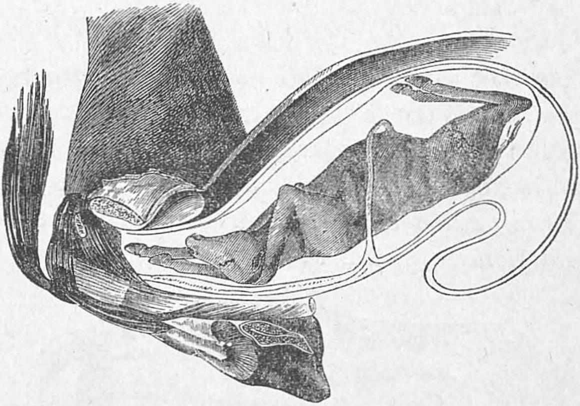


Fig. 141. Anterior Presentation : Fore limbs crossed over the neck.

may lacerate the vagina. The rectum may be perforated and the perineum may be ruptured.

If the fœtus is not advanced, the hand may be introduced and the leg seized and drawn out so as to come to its proper place. If both the legs are over the head then the pasterns should be caught and roped, while the head should be repelled. This will usually make the fœtus take up the normal position. Then the head may be brought back to the pelvic canal by traction.

1499. C.(1) ANTERIOR PRESENTATION

(d) Fore limbs incompletely extended.

This abnormality is commoner in the cow when the legs do not advance in the ordinary way with the head. In this case, the elbow joint gets placed against the thorax, and, therefore, present greater than normal width to the pelvic opening. They get stuck up there. When the nose and the hoofs appear together, they give the danger signal that all is not well. The nose may even be in advance of the legs.

In order to correct the position when the body is not impacted, the head of the calf should be pushed back to the uterus taking the legs with it—which should be kept corded. A pull at the cords, keeping the head pushed back, straightens the legs and the presentation then tends to be normal.

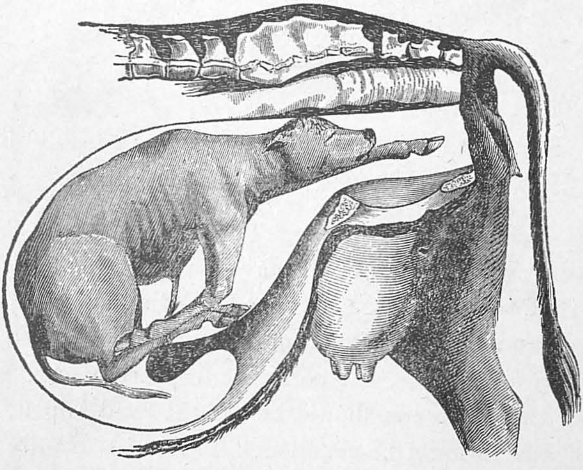


Fig. 142. Anterior Presentation : One fore limb retained completely.

If the calf is impacted, forcible repulsion may be tried to correct the position. If the calf is dead, and if the head is far advanced, operation may be made simple by decapitating the calf and then pushing the body inside, when the legs may be extended, and drawn out,

1500. C.(1) ANTERIOR PRESENTATION

(e) Complete retention of both the legs.

When the head comes out straight, without carrying with it one or both the legs, the situation becomes serious. The legs in this case remain completely folded back and the withers and the thorax thereby become so large in diameter that the calf can by no possibility be thrown out. Manipulation

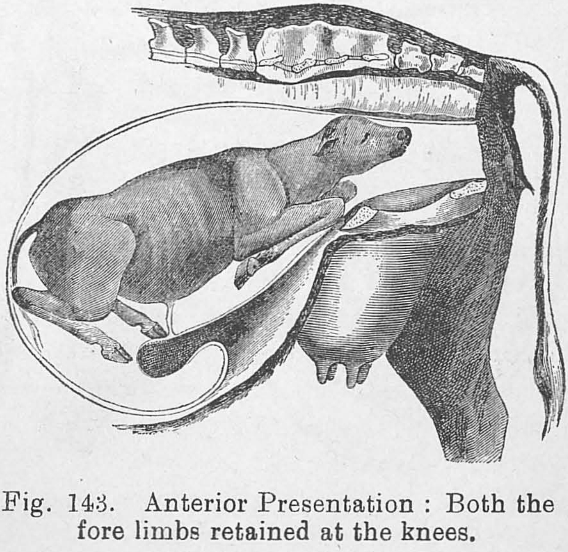


Fig. 143. Anterior Presentation : Both the fore limbs retained at the knees.

should be the same as for the folded leg presentation. The body should be pushed back and the fore arm should be caught and corded and traction applied. By manipulation both the legs should be drawn out if necessary, keeping the head repelled by the repeller.

If the foetus is strongly impacted, the case becomes one for embryotomy.

1501. C.(1) ANTERIOR PRESENTATION

(f) Abnormal presentation of the head.

Deviation of the head from the normal position may happen alone or in combination with any of the abnormalities of the fore leg presentations.

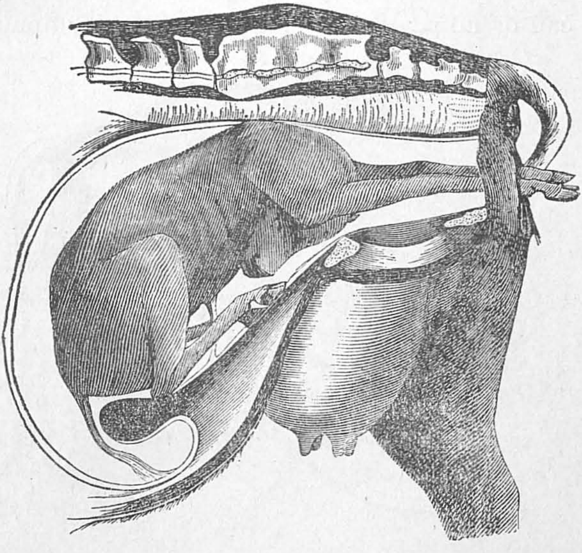


Fig. 144. Anterior Presentation : Extreme downward deviation of the head.

The head may be deviated downwards, in which case the nose approaches the trachea. For correcting, the hand should be introduced and the nose gripped and pulled out to its normal position. When there is more or less impaction the jaw may be noosed and pulled while the head may be forced back, thus correcting the fold of the head.

1502. C.(1) ANTERIOR PRESENTATION

(g) Sidewise deviation of head.

This is a serious deviation and the contracting-propelling force of the uterus makes the deviation more pronounced at each contraction. The head remains inside while the legs may make their

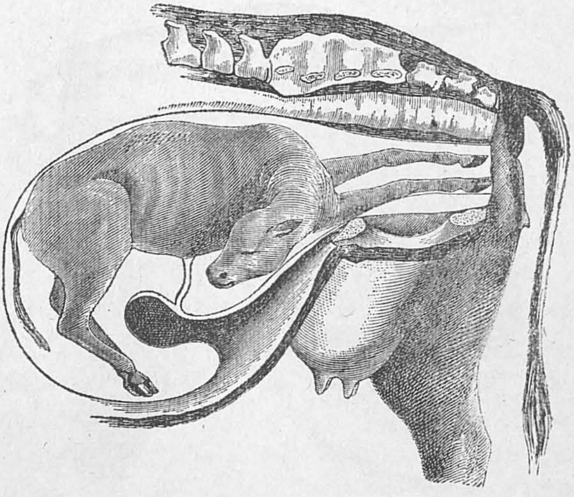


Fig. 145. Anterior Presentation : Head and neck retained.

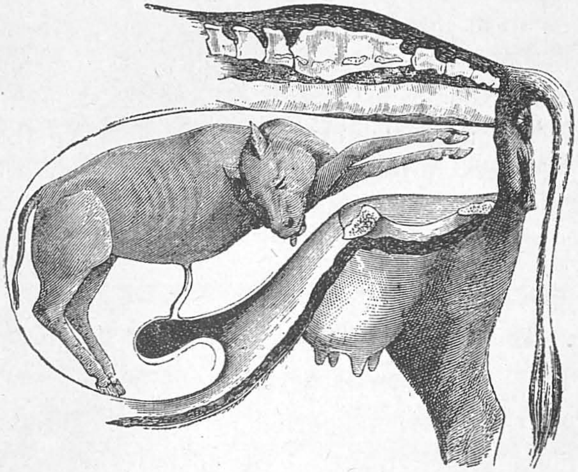


Fig. 146. Anterior Presentation : Lateral deviation of the head towards the shoulder.

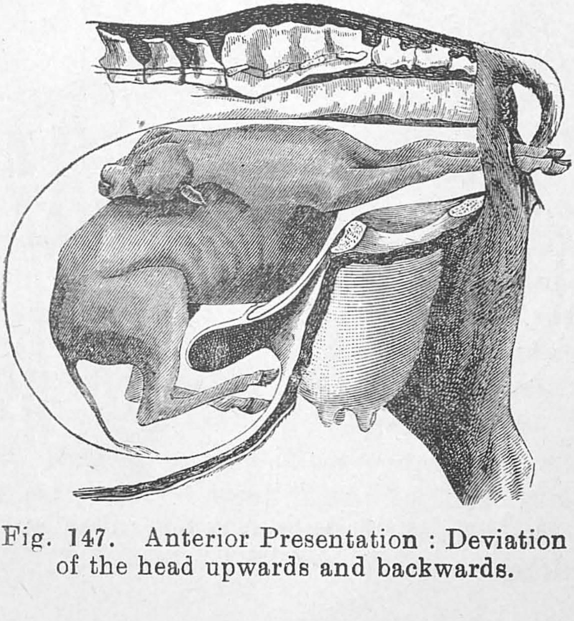


Fig. 147. Anterior Presentation : Deviation of the head upwards and backwards.

appearance. In this position reduction is necessary as the folded head can by no means pass through the pelvis. The foetus should be repelled and by grasping or noosing the jaw the head should be straightened by pulling.

1503. C.(2) POSTERIOR PRESENTATION

In the posterior presentation the hind part is presented first to the pelvic canal. If the two hind legs are presented in the same position as the fore legs are presented normally, then there may be natural delivery. The two hind legs serve the purpose of the opening cone and then the croup is presented to the already dilated passage. But this simple presentation is variously deviated from. Cases may occur where the calf is pushed to the pelvic canal not only with posterior presentation but also in a *reversed* attitude, i. e. the ventral aspect of the calf faces the vertebrae of the dam. This is a difficult position. The body of the calf forms a curve which is reverse to the pelvic curve. This creates difficulty.

In the posterior presentation the abnormalities occurring in anterior presentation may also be encountered with, The head may be folded to one side or another, or the legs may be folded, offering obstruction which can be rectified only by pushing the calf back towards the uterus and by manipulating with the help of traction and repulsion.

1504. C.(2a) POSTERIOR HOCK AND BREECH PRESENTATION

The calf may appear at the pelvic canal in the lumbo-sacral position in posterior presentation. In this position the hind limbs may not be quite extended. When this happens it is called hock presentation. In place of the fore legs and the head appearing, in this presentation the croup and the

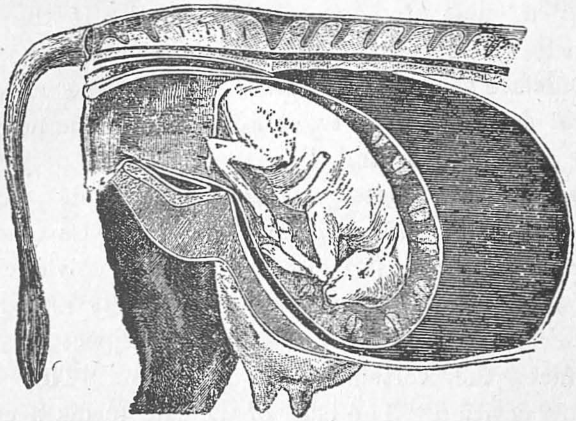


Fig. 148. Thigh and Croup Presentation.

folded hock appear and get wedged in the canal. Mere pulling may lacerate and then rupture the vaginal passage. Once the croup gets wedged in, it is difficult even to effect retropulsion. Both the calf and the dam may perish. Retropulsion should be attempted and the position corrected so as to bring out the hind legs first in a straight position, This can be done after pushing down the calf and keeping it in that

position with the help of the repeller and drawing out the hind legs by cording the hock.

In breech presentation the hock instead of being folded, remains open. This is more difficult than hock presentation for there is greater chance of the croup entering the pelvis and getting stuck up there. The manipulation would be very nearly the same as in the case of hock presentation.

1505. C.(3) TRANSVERSE PRESENTATION

In the transverse presentation the short axis of the calf is presented instead of the long axis as in anterior or posterior presentation.

1506. C.(3a) TRANSVERSE : DORSO-LUMBAR PRESENTATION

In this presentation nothing appears at the vulva, although the water bag may have been ruptured long ago. In this presentation the back of the fœtus is at the pelvic opening, and both the pairs of legs are exactly opposite. Internal examination will reveal only the rounded back of the calf. The head and limbs cannot be reached or felt.

Such cases are rare but when attended to early both the calf and the dam may be saved. The fœtus in this instance cannot enter the pelvis and, therefore,, cannot get itself jammed, however strong may be the force of contraction.

As the foetus is outside the pelvic canal the manipulation consists in pushing and rotating the

foetus in such a way that either anterior or posterior presentation may be effected, whichever is more easily possible. The passage should be lubricated. Retropulsion applied, and at the same time it should be so directed that the desirable part may face the pelvis.

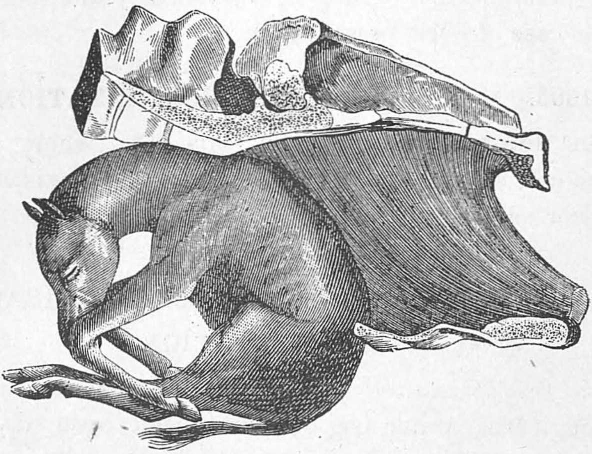


Fig. 149. Dorsal Transverse Presentation.

1507. C.(3b) TRANSVERSE : STERNO-ABDOMINAL PRESENTATION

In this presentation usually one or all the legs enter the genital canal. They may project out at the vulva and there get choked. In this presentation also as in the previous one described the foetus cannot get jammed in the pelvic passage. By an internal examination the head may be reached. The examination may reveal the placing of other parts of

the body which may help in deciding the course of version which is to be adopted.

This presentation is one of the most difficult ones, but is less troublesome than the previous one described. By retropulsion and rotation the position may be changed specially by using oblique traction.

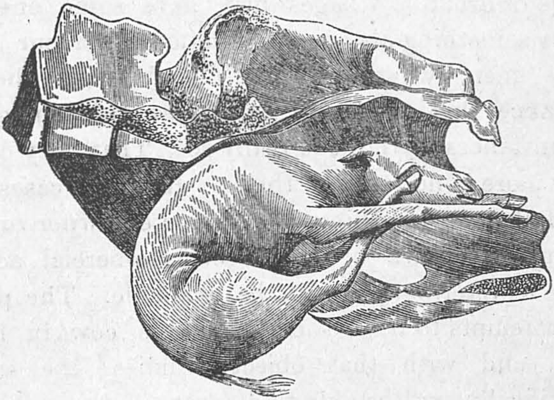


Fig. 150. Transverse Presentation : Nose and all the four limbs presenting.

There is danger in far thrown out retropulsion, for the legs may stick into the uterine wall and rupture it.

1508. PRECAUTIONS AND MANIPULATIONS IN DYSTOKIA

When a veterinarian is called in to attend a cow which has been under prolonged labour pain, it is very likely that by the time he reaches there, he will find that the stage of aid for saving both the calf and the mother has passed. The calf is either dead or is so

locked up that there is not much left to be done to save it. The mother then becomes the only object of care. And even then it may not be possible to do much. The reason is that there is much delay and mishandling before a veterinarian is available to attend to cases of difficult labour in the villages. Every village or group of villages may have some one who knows something about manipulation of labour cases. These men, whatever they do, do with the full assurance that they are doing the best under the circumstances. And it is really so. That they do not know more is no fault of theirs. In those cases that they fail to do any thing, the distracted owner runs to the nearest town or centre of commercial activity where a veterinarian may be available. The person who attempts to be of some use to a cow in labour pain, and with that object studies the subject scientifically, will be able to do very much more in the village where he works or in a circle of villages round about him, than the qualified veterinarian stationed at a distant place. Time is a great factor. The aid must be available in time in order to be of use.

Even in villages a local man with a scientific knowledge of obstetrics, may not be called in timely. In such an event, it will be found that the mischief is already done, and in cases of malpresentation the calf is impacted and wedged in the pelvis except in the case of transverse presentation, which by its very nature does not allow any portion of the fœtal body to enter the pelvis on account of the width of the surface presented.

Where the water bag has ruptured, as will be found in most cases, and the fluid has run out, the parts in contact will be found to be dry and sticky.

1509. THE LUBRICATING FLUID

The first thing prior to an internal examinatiou would be, when the water bag is ruptured, to apply a lubricating fluid to the vagina and all approachable surfaces. The most suitable substance is the linseed mucilage. Linseed mucilage can be made by boiling linseed in water. The water becomes jelly-like, in which the seeds remain suspended. This mass is strained through cloth. When cooled, the jelly is ready for use. 4 or 5 gallons of this jelly may be necessary to handle a case. In case of tight impaction, it may not be possible easily to lubricate the interior. A douche-can provided with a stout catheter may be introduced bit by bit by allowing the liquid to flow and then withdrawing a little and again pushing, the flow being allowed to continue by keeping the pinch cock on the rubber tube open.

A better method for introducing mucilage would be to do so with a metal syringe acting like a suction and force pump to which a rubber delivery tube is attached. For, according to the state of dryness, mucilage may require to be introduced up to 5 gallons which may be difficult to accomplish otherwise.

Linseed mucilage is to be made as follows :

Linseed	...	1 lb.
Water	...	10 lbs.

Boil for 15 minutes, and strain.

1510. STERILISATION OF APPLIANCES

Next, the instruments necessary—the cords, the hooks, crutches, knife etc. should be sterilised by boiling in water.

The cords should be new and soft. New jute rope of about half inch diameter may serve in many cases. Where exceptional strong traction is necessary, hemp rope of half inch diameter will serve the purpose. The ropes should be singed by passing lightly over a burning fire, to clean it of loose fibres. The singed rope is then fit for sterilisation by boiling. It is safe to use new rope every time and discard the used ones, which are rather difficult to keep in a sterile condition. For this purpose several bundles of different sizes of ropes are to be kept in the labour appliances set, ready for use any moment.

1511. INTERNAL EXAMINATION

The arm up to the full length should be lubricated and then introduced into the genital organ and the position of the fœtus felt. If the vagina and the pelvic cavity are blocked tight by some part of the fœtus, then the approaches should be lubricated and retropulsion applied. The force should be gradual and steady. Sufficient force, however, should be applied to make the fœtus move in the direction of the uterus. The retrovertor or repeller may be the simple Kuhn's crutch or it may be the Baron's (modified) obstetric machine mentioned in Para 1520.

Whatever be the appliance, the force should be gradual and steady. Spasmodic and jerking pressure

may cause grave injury to the vagina or to the uterus. A repelled fœtus will then allow fuller lubrication to be applied to the passage and the cervix. If the interior of the uterus is dry, it should be liberally lubricated by allowing the linseed jelly to fill in. The hand may then be introduced to feel the position of the fœtus and decide what steps need be taken.

If the impaction of the fœtus against the passage is so great that the fœtus cannot be moved either way, then, of course, the fœtus has to be delivered by embryotomy.

During an internal examination it is necessary to ascertain the relative positions of the fœtus, uterus and the passage and whether the calf is dead or alive and also to find out where the fault lies, whether it is maternal or fœtal and whether it is due to the excessive size of the fœtus or monstrosity or if it is due to faulty presentation.

The steps to be taken for meeting thc emergency should be decided upon on the results of the examination.

In case of malpresentation one or other of the processes have to be adopted :

(1) Retropulsion,
(2) Rotation,
(3) Version,
(4) Extension and flexion,
(5) Traction.

These processes and their purpose are described later on.

1512. THE COW IN DIFFICULT LABOUR

Whatever be the process applied, its suitability should have reference to the condition of the cow.

It is best to keep the cow remain standing during an examination. For this purpose it may be enough to hold it in the front by a familiar attendant to keep it steady. Standing position is the best position both for examination and for manipulation.

It may, however, be necessary to make a cow to assume a recumbent position or to lie on its side or on its back. It should be possible for the veterinarian to bring the cow to assume these positions without much resistance, and quietly.

To make the cow assume a recumbent position or to lie down, the best way is to apply restraint as described in Para 1477.

During manipulation it may become necessary to raise the hind part of the cow. The hind portion may be raised by piling litter below the hind feet and making the animal stand on it. An unsteady animal in a standing posture may be kept steady by one person holding the nose with the fingers pinching the septum and two assistants standing on either side of the cow and pressing from each side. A man may be replaced by a board at one side.

In a recumbent position it is more difficult to conduct manipulation than in the standing position. The cow sometimes remains recumbent and refuses to rise. This may be due to inability and exhaustion; but some cows may refuse to rise merely out of cussedness. Coaxing to make her get up may

sometimes succeed. The appearance on the scene of an unknown dog may make the cow get up. When these means fail, the cow should be allowed to be, and the manipulations adjusted by the operator to this position. It may be found necessary to take the load off the uterus and bring the fœtus somewhat to a raised position. For this purpose a stout sheet may be passed under the abdomen and brought up to the back. The sheet may be tucked up and tied by a rope passing over a pulley or roller fixed to a vertical support above the croup of the cow. Two stout poles may be dug in on the earth in an inclined position, their tops meeting each other. This will give support to the pulley, or a smooth bamboo may be tied to the poles near the top to let the rope glide over it.

In some cases it may be an advantage if the cow rests on its sternum with the legs folded. This can be accomplished by suitable means. On other occasions the cow may have to be placed on her back. In most cases of transverse presentation, this position of the cow is helpful. While the cow is on her back the legs should be bound together to prevent any movement.

1513. THE COW AND THE OPERATOR

The obstetrist will often find the job exhausting. In fact, attending difficult labour duty can be performed well by men with a stout constitution who are not easily fatigued. The arms of an operator should be fairly long so that by pushing in, he may explore much of the fœtal body. While the arms should be long the

fingers should be stout and short, allowing firm grip. A short-armed long-fingered man is a misfit for the job.

In obstetrics the hands of the operator are the principal instruments. Other mechanical appliances are there, but the main work is of the arm, the fingers and the wrist. Physical fitness combined with experience only can make an efficient operator.

The operator may have to use either the right or the left hand according to the position of the limb, and one who can apply force equally with either hand for long periods will find matters simplified as compared with a man who has not practiced the use of both the hands.

The operator may have to lie down, when the cow is in a recumbent position and from that position struggle for correcting flaws in the process of delivery.

1514. ANAESTHETISING

The operator should be alive to the pain he causes to the cow in his manipulative and other operations. Quite often he will find that the animal is exhausted by long-continued labour pain and is unable to rise. The amount of exhaustion already incurred should be estimated. The time which may elapse in future in handling or operating should be considered and also the amount of pain involved in it.

Now-a-days the obstetrists generally are inclined to anaesthetise the animal prior to introducing mechanical interference. The reason is obvious.

In cases of dystokia the amniotic fluid continually gets less and less. Besides, as soon as the hand may

be introduced extra straining commences. Now, in changing the position of the fœtus, two forces have to be counteracted. One is the action of the abdominal pressure and the other is the tension of the uterus in close contact with the body of the fœtus. Slight movements of the arm may give rise to severe straining and thereby baffle all attempts at rectification. If a mucilage was introduced for lubrication, the whole or the greater part of it is expelled. The space necessary for reaching and manipulating the fœtal parts goes on diminishing with the continuation of attempts.

If, however, epidural anæsthesia is applied, the abdominal and more or less the uterine straining gets removed and there is relaxation providing space for manipulation. Benesch strongly advocates the use of **epidural anæsthesia in** obstetrical practice as under:

"(1) The pain accompanying operative interference is either entirely abolished or greatly reduced, the effect which is of great importance from the humane standpoint.

(2) The linseed infusion introduced as a substitute for the liquor amnii is not, as otherwise often happens, immediately ejected, but becomes distributed slowly and evenly between the fœtus and the uterine wall, thus causing a considerable loosening between the mucosa and the surface of the foetus. This results in the restoration of the mobility of the fœtus within the uterus.

(3) A natural result of the relaxation of the uterine wall consequent upon the absence of abdominal pressure, is that the space required for the

reduction of displaced fœtal parts or for the rotation of the fœtus on its longitudinal or transverse axis is produced, and reposition can be effected without resistance on the part of the mother. The degree of relaxation corresponds with the degree of anæsthesia present.

(4) As defæcation is suspended for the duration of anæsthesia, the operation is clean and asepsis is more easily maintained.

(5) Its application when properly performed is, in the author's opinion, entirely free from danger.

(6) Normal involution of the uterus is not interfered with.

The introduction of epidural anæsthesia, however, does not imply that it should be employed as a routine in every case. It is not necessary in those in which internal examination indicates the probability of a rapid and smooth course of delivery."

—(*Veterinary Obstetrics* ; Benesch-Wright ; P. 8)

It will be apparent from the above that except in cases where the operator expects to have a "rapid and smooth course of delivery", he will be well advised to use epidural anæsthesia in cases of dystokia.

The technique of epidural anæsthesia is described in para **1480**.

RECTIFICATION PROCESSES IN MALPRESENTATION

1515. (1) RETROPULSION OR REPULSION

The veterinarian often finds the fœtus in such a position that before he can attempt to do anything he

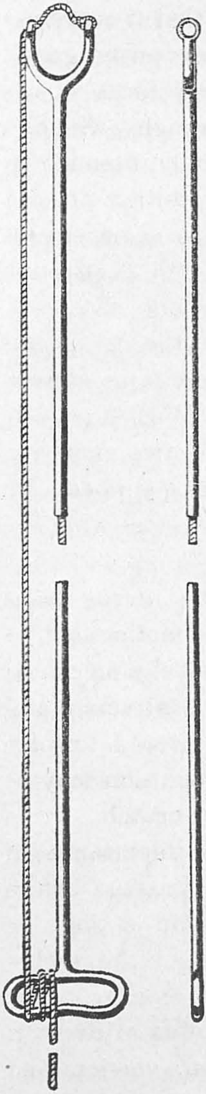


Fig. 151. Kuhn's crutch.

must lubricate the site with linseed mucilage and then push the fœtus away to introduce his hand to understand how exactly the fœtus is placed. Even in case of normal presentation, when the labour is delayed, the operator may have to search for the fore legs and cord them to draw them out. This is possible in most cases after the fœtus has been thrown forward towards the uterus and repelled. This work may be sometimes easy and may be performed with the hand unaided by any instruments. But in the majority of cases it will be found that the hands are not sufficient for the work. Instrumental aid has to be taken.

The most suitable position for retropulsion is the standing one. Even when standing, great advantage will accrue by raising the hind legs, as thereby the uterus and its contents are thrown away from the passage.

For giving aid some simple but efficient instruments are in use. There are several forms of these. One of the best and most suitable instruments is Kuhn's crutch.

The advantage of Kuhn's crutch is that it combines in it the facilities given by a crutch for pushing and also of a snare for pulling. The two forks of the crutch end in two fixed rings through which a rope is passed. The crutch was originally intended by Dr. Kuhn for correction of the flexed position of hock joints. But the instrument seems to be indispensible for the correction of other anomalies. The illustration shows, a screw jointed handle. This is not necessary. In rotating in the left handed way the joint gets unscrewed. A single piece as a handle is recommended. It is about 33 inches long. With the help of this instrument simultaneously the two opposing forces of repulsion and traction may be applied. In most obstetrical cases Khun's repeller does what the hand can not do.

The spasmodic contraction of the uterus takes place even under the influence of hypnotics such as chloral hydrate. But complete anaesthesia as can be assured by the epidural method stops contraction and allows the necessary relaxation of the uterus to take place,when the needed action of retropulsion may be performed with the aid of the repeller crutch. It is necessary to emphasise upon the importance of lubrication of the uterus and genital passage before attempting retropulsion. In retropulsion it may be found not only necessary that some part of the foetus should be secured for receiving the repeller, but it may be equally necessary to apply traction or rotation to other parts. Retropulsion, rotation, version and traction etc. really may form the separate wings of the

Fig. 152. Example of Correction.
Correction of flexion of fore leg by repulsion with the crutch and traction by the hand.
(Benesch)

Fig. 153. Example of Correction.
Flexion of the fetlock joint by repulsion and traction.
(Benesch)

one composite process, namely rectification of the malpresentation.

1516. (2) ROTATION

It is found frequently necessary to rotate the foetus one way or the other, in order to bring it to occupy a position from which it can be made to travel the pelvic and vaginal passages without injury. For effecting rotation the preliminary precautions of anæsthetising and lubricating have to be performed as in the case of retropulsion just described. The foetus is to be pushed away, but before that, some part of the foetus should be held secured in a noose so that when occasion arrives that part may be pulled in. In case of rotation the hand may be placed under the body of the foetus and on the floor of the pelvis. The arm may be used

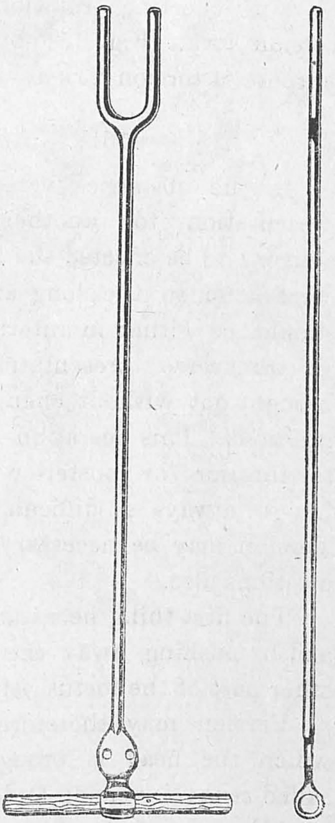


Fig. 154. Torsion fork.

as a lever for turning the part in hand to the right or left.

During rotaion the abdomen may be raised to advantage. Often the conversion to a lateral position is enough. Afterwards by traction it may be possible to bring the foetus to the proper position, the rotary action being helped by traction.

For effecting rotation the instrument is the torsion fork, (Fig. 154) but the crutch may serve the purpose of torsion fork as well.

1517. (3) VERSION

In the obstetrics version is the conversion of one presentation to another by manipulation. For delivery to be effected the long axis of the foetus must correspond to the long axis of the dam, i.e., the calf should be either in anterior or posterior presentation. In transverse presentation the foetus can not be brought out without changing it to either of the above positions. This operation of changing from transverse to anterior or posterior position is called version. It is always a difficult manipulation to perform. Version may be necessary in some of the posterior positions also.

The first thing necessary here again is retropulsion and by pushing away the oval mass to bring some other part of the foetus before the pelvic inlet.

Version may therefore be of two kinds. One in which the head is brought towards the pelvic inlet called *cephalic* version and other in which the posterior or pelvic part of the foetus is brought to the pelvic

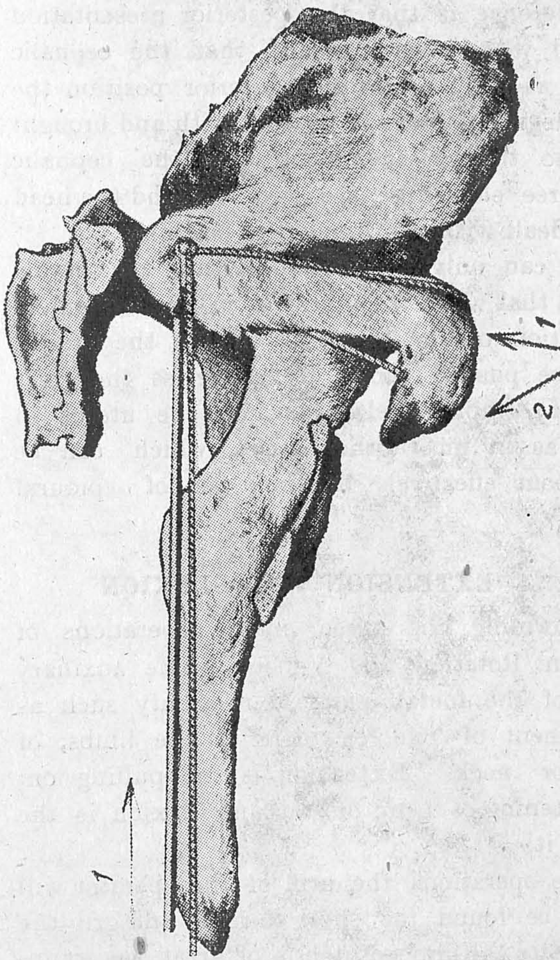


Fig. 155. Example of Correction.
Correction of hock flexion by repelling by crutch and traction by the snare.
(Benesch)

inlet of the dam called *pelvic* version. Many prefer the pelvic version to the cephalic version. The reason of the preference is that the posterior presentation is attended with lesser difficulty than the cephalic position in as much as in the posterior position the two hind legs only have to be dealt with and brought correctly to the passage, whereas in the cephalic position three elements ; the two legs and the head have to be dealt with and brought to position.

Version can only be effected within the uterine cavity, and that when the uterus is in the abdomen. If any portion of the foetus is outside the uterus, it has to be pushed back. Hence arises the great necessity of complete relaxation of the uterus in this case, as in most other cases, which can be brought about effectively by the use of epidural anæsthesia.

1518. (4) EXTENSION AND FLEXION

In performing the three main operations of Retropulsion, Rotation and Version, some auxiliary movement of the foetal parts is necessary such as the adjustment of one or more of the limbs, of the head or neck. **Extension** is the pulling out and straightening of bend or fold and **flexion** is the opposite of it.

In these operations the arm of the operator will very often be found too short to reach and grip the necessary parts. Kuhn's crutch is of great aasistance in these manoeuvres. Often flexion and extension have to be performed simultaneously.

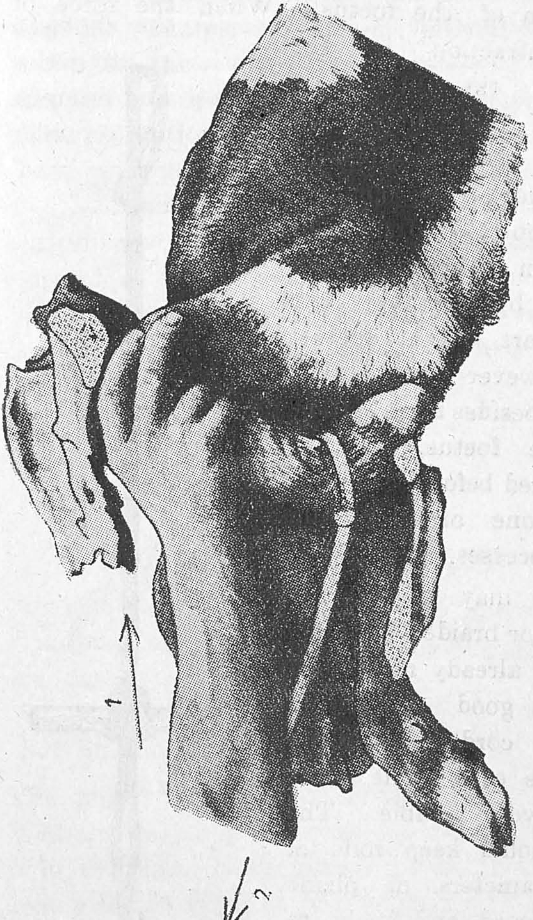


Fig. 156. Example of Correction.
Correction of carpal flexion by traction by snare and repulsion by the hand.
(Benesch)

1519. (5) TRACTION

Traction is the employment of mechanical means for extraction of the foetus. When the force of uterine contraction is not enough, or the uterus is kept relaxed, then the foetus has to be manipulated out. But the hand of the operator may not be enough to perform this task. In this case traction is applied by cording one or several part of the foetus. Cording however has other applications besides mere extraction of the foetus, as has been explained before. Cording is to help one or all of the foregoing processes.

The cord may be in the form of rope or braided flat tape. It has been already mentioned that it is a good practice to throw away cords after using them for one case. The cords should be very pliable. The obstetrist should keep rolls of different diameters of pliant cords. The cords and hooks to the veterinarian are what the delivery forceps are in delivery cases for women. A handle

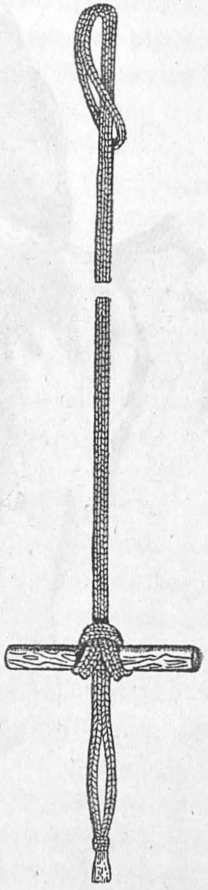


Fig. 157. Cord loop for traction with a handle attached.

may be attached to the end of a noose for better traction.

The cords and nooses and hooks are as useful in correcting malpresentation or extraction as they are useful in the case of embryotomy. Double hook through rope passed in behaves exactly like forceps (Fig. 160). Blunt hooks are used in the living foetus.

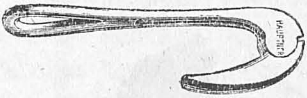


Fig. 158.
Blunt hook.

Fig. 159. Short sharp crotchet with round point.

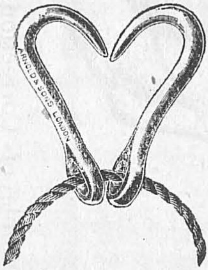


Fig. 160.
Obstetric double hook.

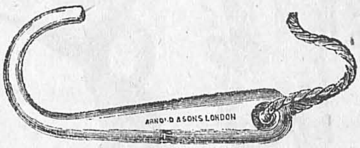


Fig. 161.
Blunt hook.

The most suitable place is the socket of the eyes. Without injuring, traction can be applied with the help of these blunt hooks (Figs. 158-161). Dead foetus and parts of it can be managed only with the help of sharp hooks, for which they are indispensible.

For mechanical traction, the pull of an assistant or two may not be enough. Sometimes pulley blocks

are fixed to a post and the foetus drawn out by its help. The difficulty with these and similar methods of direct pull is that the cow may also be backing with traction even when held by a man or two in front.

Baron's obstetric machine has been devised to allow traction to be applied to the foetus under which

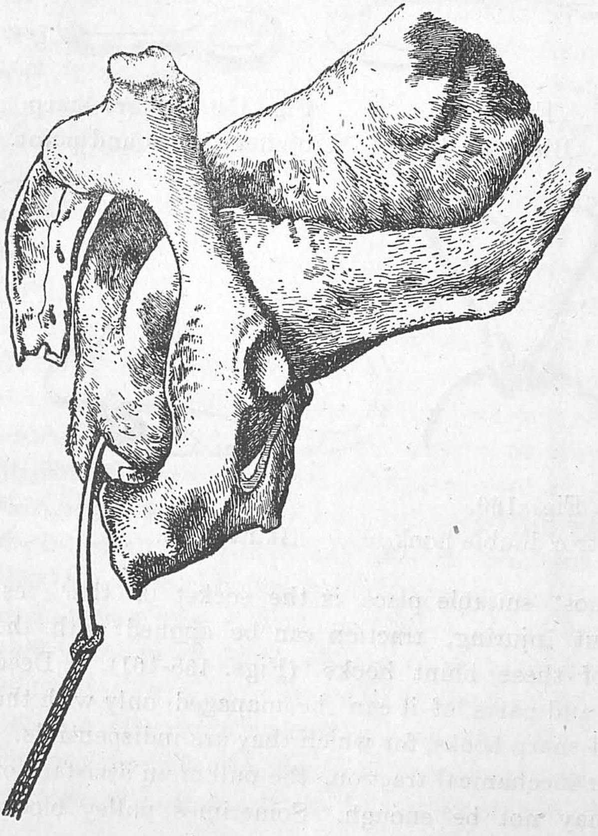


Fig. 162. Example of Correction. Use of anal hook in extracting a dead fœtus in breech presentation. (Benesch)

the cow may remain steady. The appliance is called **Baron's obstetric machine**. It consists of a kind of horse collar which is applied to the hind part of the cow. In the collar there is provision for three rods to be stuck into it, which end in a plate having screw thread cut in its central hole. Through this screwed aperture passes a screwed rod with a handle at one end. On the other end of the rod is a chain or a rope to be attached to the foetus. The end of the screw piece terminates in a loose collar kept in position by a pin in the groove of the screw terminal so that the rotary movement of the screw is not transmitted beyond it, to the chain or rope, while the shank of the central screw is operated. By applying unscrewing motion to the handle, the screw along with the corded foetus attached to it is drawn out, while the hind part of the cow is kept pushed away by the collar.

This appliance is designed only for applying the force of traction on the foetus. We have, however, seen that as great a force of repulsion may be necessary to disengage an impacted foetus from the pelvic passage. There is little room in case of repulsion to apply force by more than one person, which is not the case with traction. In the case of traction a rope may be fixed to the foetus and the pull exerted by a number of men provided that the cow is held steady by the application of the opposing force by another set of men. But in case of retropulsion no such opportunity exists. It may happen that by a properly exercised force of repulsion, a foetus may be forced back and then embryotomy applied and the mother saved. But

if sufficient repellant force cannot be applied, no embryotomy may be performed and one may have to be a helpless on-looker and see the mother perish in agony.

By a modification of the Baron's machine the force of retropulsion may be applied with equal effect as in the case of traction.

1520. BARON'S OBSTETRIC TRACTION-REPULSION MACHINE (MODIFIED)

For applying forces of traction or retropulsion on the foetus, at will.

In this modification there is another collar corresponding to the one placed on the hind part of the animal. This second collar is placed around the neck just like the collars that are placed on the neck for pulling a cart.

The front and the hind collars are joined by ropes passing through appropriate hooks fixed on each. The two collars now form a composite piece. The hind collar has all those appliances as were in the Baron's machine with this exception that in place of the chain it has a single plate and rod, ending in a Kuhn's crutch which may be replaced by rope and hook. There are some other minor alterations also. The modified machine is illustrated on the opposite page.

G and H are two collars one at the hind part and the other on the neck of the cow. The two collars are fastened in their places by the pull of the

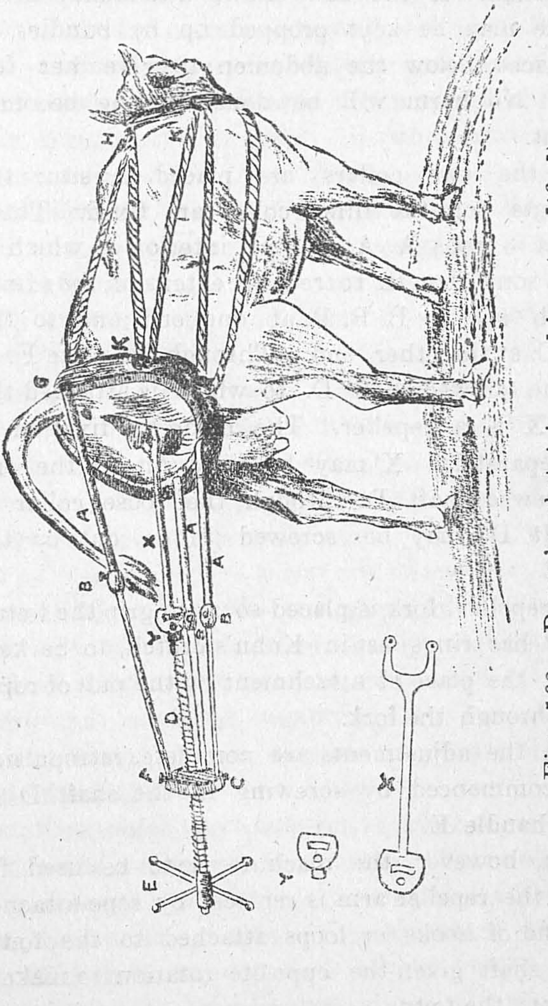


Fig. 163. Baron's obstetric machine (modified).

GH collars for hind part and neck. KK hooks through which ropes pass. AB are rods attached to plate FC. E handle turning screw D. joined to repeller.

tying rope passing through hooks K. K on the collars. After fixation by ropes the collars remain steady in their position. If the cow shows a tendency to lie down, she may be kept propped up by bundles of straw placed below the abdomen to give her full support. No harm will be done if she becomes recumbent.

After the two collars are placed in situ, the attachments for the hind collar are fixed. These consist of 3 rods A. A. A. the interior of which is hollow to some length to receive extension rods fixed by thumb screws B. B. B. at one end and to the plate F. C. at the other end. Through the plate F. C. passes the screwed shaft D. to which is attached the arm X. X is a repeller. The mode of fixation is shown separately. X may be fixed on to the end of the screwed shaft D. through the loose collar Y. The shaft D may be screwed in or out by the handle E.

The repeller fork is placed so as to grip the fœtus. The fork has rings as in Kuhn's crutch to be kept steady at the place of attachment by the pull of ropes passing through the fork.

When the adjustments are complete, retropulsion can be commenced by screwing in the shaft D by turning handle E.

When, however, the machine is to be used for traction, the repeller arm is replaced by rope attached to the end of hooks or loops attached to the fœtus and the shaft given the opposite rotation to make it recede from the fœtus.

1521. EMBRYOTOMY

Embryotomy is the reduction of the volume of the fœtus by mechanically removing certain parts of it when the foetus cannot be delivered as a whole.

Various parts of the body may have to be cut, separated and withdrawn. When there are deformities in the mother animal or when the foetus has monstrosities, or when the malpresentations cannot be corrected or when the jammed body cannot be extricated, then arises the necessity of removing the foetus, part by part, to save the life of the mother. To cut the foetus and divide it with the help of only one hand, without seeing it, is a difficult and fatiguing task. Mention has been made (**1513**) of the strenuous physical exertion needed in delivery cases. In affecting embryotomy, this observation applies with greater force.

The lubricating fluid having escaped long ago, the membranes becoming sticky, adhere to the fingers. The tissues of the foetus are flaccid and escape away from the knife. With all these, and with the region of work far remote from the operator, the work has more difficulties than one can imagine. To add to this the maternal organ may be lacerated and so swelled that it may become a problem to introduce the hand at all.

The operations involved are mostly of the nature of cutting, tearing or crushing. For cutting many instruments are in use. A sharp pocket knife with a strong spring so that it may not easily fold back and with a hole at the end of the handle is a good substitute for many specially designed knives.

The presence of a hole in the handle is necessary for passing a cord through it and fixing this with the wrist of the operator. In case the instrument slips from the hand, it can be pulled up and recovered. All small instruments taken inside the vaginal route should have this sort of attachment, otherwise great mischief may happen. If a pocket knife is not liked, then the surgical knife of choice has to be used. The knife should have its blade opened out. The handle

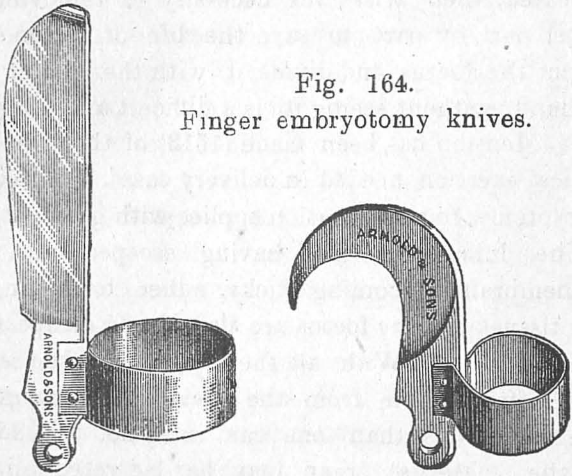
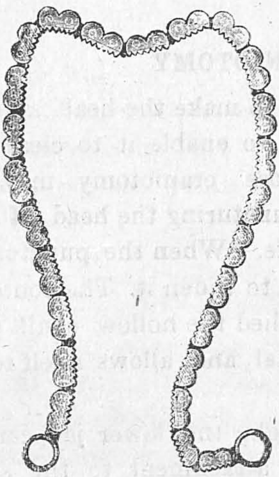


Fig. 164.
Finger embryotomy knives.

being held within the palm, the blade is to be protected by the fingers from underneath so that the hand with the knife may be easily introduced through the vulva. Some patterns of veterinary knives are provided with gliding guard. The guard is pushed off when the knife is to be used. Others have spring arrangement by which the blade can be shot out from the handle when needed and kept

locked. But the less the complications in the instruments the better they are for use.

Besides the cutting knife, there is the necessity of using some bone cutting arrangement occasionally. This is provided by a long-handled chisel having a V.-shaped face which is sharp but the corners of which are blunt. Such a chisel may, after introduction, be guided by the hand to present its V edge to any bone.



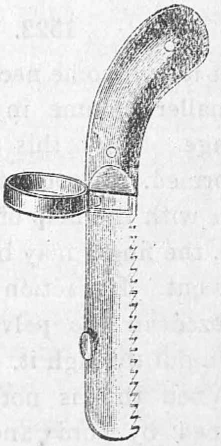


Fig. 165. Chain saw. Fig. 166. Hand saw.

The hand holds it there, while the assistants may strike the chisel handle outside the vulva with a mallet, to cut through the bone ; the hand in the interior guiding the head of the chisel.

Sometimes a wire-saw or a jointed chain-saw becomes useful for separating the parts. The wire saw is guarded by armoured tubes upto the point where

cutting is to commence. The chain or wire-saw passes round the surface in a loop and by operating the two ends from outside, the edge of the saw cuts through the desired structure.

For pulling out cut portions hooks are used. Pointed hooks may be stuck suitably on flesh and traction applied on the attached rope. The crutch also finds its utility in embryotomy.

1522. CRANIOTOMY

It may become necessary to make the head assume a smaller volume in order to enable it to clear the passage. For this purpose craniotomy may be performed. It consists of puncturing the head of the fœtus with the help of a knife. When the puncture is done, the finger may be used to widen it. The contents come out. If traction is applied the hollow skull gets squeezed in the pelvic canal and allows itself to be drawn out through it.

When this is not enough, the lower jaw can be fastened by cord and its attachment to the skull ripped by the knife as far as possible. On employing the force of traction, the partially separated jaw comes out. This may allow room for the head to come through.

1523. DECAPITATION

It is the separation of the head completely from the body. It has its dangers and should be performed

only when absolutely necessary, as in the case of a double-headed monster. There is a danger of injuring the mother when decapitation is performed on account of the rough edges of bones being exposed.

1524. AMPUTATION OF THE LIMBS

This has often to be performed and is not a difficult operation in the hands of a skilled person. The limb is corded ready to be pulled and the skin is separated at the shoulder or pelvic joint. By the help of traction the muscles and ligaments tear and the limb is taken out. Sometimes it becomes necessary to amputate only upto the knee and take out the disjointed portion. This can be done when properly manipulated.

1525. DIVISION OF THE BODY

In certain cases the trunk gets fixed up in the pelvis in such a way that there it has to be cut into two, to draw off the first portion and then deal with the second portion. For this purpose the fœtus should be drawn out as far it can come and cut just near the vulva. Before division, some portion of the skin is to be separated and kept so that after the division, the skin may be sutured and a rounded surface made of the remaining portion. Pointed hooks may be embedded in the body and the remnant of the trunk pushed away. Then the remaining portion may be manipulated and brought into position before the pelvic opening and drawn out.

1526. WITHDRAWAL OF VISCERA

It may become necessary to withdraw the visceral organs first in order that the remaining parts may be withdrawn. The abdomen may be opened and the contents pulled out.

Each case will of course present its own problem. The general methods described may only give indications as to what is to be done in every individual case.

CHAPTER LVIII

GENERAL INFORMATION AND GLOSSARY

Alteratives : Alteratives are those remedies that alter the processes of nutrition and excretion and restore the normal body function, e. g. Arsenic, Iodine, Iodides, Calomel, Soda Bicarb, Nux Vomica and Bitters.

Analgesics are drugs that relieve pain. The term is restricted to the drugs which cause only loss of sense of pain without loss of consciousness. Those analgesics that work on the nervous system are called anodynes and and those that act locally are called local anaesthetics.

Ankylosis : It is the union of the bones of a joint ending in stiffness. Movement is restricted by fibrous bands where the bones have not united. It is common in knee and hock joints.

Anodynes : Anodynes are drugs that relieve pain, e.g., Aconite, Camphor, Soda Salicylas.

Antacids : Antacids are drugs that reduce the acidity of the gastric contents, e.g., Soda Bicarbonate.

Anthelmintics : Substances for getting rid of helminths or worms are called anthelmintics. The principal anthelmintics recommended to be used are copper sulphate, kamla, turpentine and thymol. There are others in use such as chloroform, arsenic,

oil of chenopodium. But these are not recommended for risks of poisoning.

Antidotes are substances which counteract the action of poisons. The antidotes themselves mostly are poisons and, therefore, need careful administration. Some poisons and their antidotes are given here :

Acid, Mineral : Soda bicarb, Calcium Magnesium Carbonates, demulcents, bland oils, gruels.

Aconite : Emetics such as strong common salt solution, Tartar Emetic.

Arsenic : Ferrous sulphate freshly precipitated with a carbonate, Lime water.

Acid Carbolic : Lime water, Soda or Magnesium sulphate, white of egg.

Copper Salts : Oily purgatives, alkalies, demulcents.

Lead salts . Mag. Sulphate, Linseed oil, milk.

Mercury salts : Eggs, gruel, Mag. sulph.

Morphia : Strychnine injection.

Opium : Charcoal powder, purgatives.

Strychnine : Emetics, Chloral, Sedatives.

Antiphlogistics are counter irritants used in inflammations. Chiefly used in inflammation of the udder and in sprains. They are generally made by incorporating essential oils in a medium of kaolin and glycerine. A suitable formula is given below :

Kaolin	...	...	5 oz.
Acid Boric	...	...	5 drams,
Glycerine	...	...	4 oz.

Mix Kaolin and make into clay-like dough with water. Heat this mixture. Heat glycerine separately

and then mix the two. While cooling add Turpentine ½ dram.

Antiseptics : Substances which have the property of preventing or arresting the growth of organisms that produce putrefactive or toxic changes in animal or vegetable matter are known as antiseptics. Some antiseptics :— Mercury salts, Boric acid, Iodine, Salicylic acid, Carbolic lotion, Parmanganate lotion. *Neem* water, Thymol, common salt. Of the mercury salts mercuric chloride is the most effective, which is soluble in water. It is a dangerous poison. Calomel is a mercury salt and is insoluble. Its antiseptic properties are brought to action by ingestion.

Antispasmodics are substances which diminish spasms cr cramps. They act either directly on the muscles or upon the nervous system which control the muscles, soothing their action.

Chloroform, when inhaled, first stimulates and then sooths by paralysing the nerve endings. Opium and morphine also relieve spasms through insensibility. Chloral hydrate is a sedative to the brain and spinal cord and acts as an anti-spasmodic.

Arhythmia is irregularity of heart's rhythm such as the periodic missing of a beat. It may indicate some form of heart disease but by itself it may be a harmless temporary phase.

Arthritis : Inflammation of a joint. The chief forms are traumatic or due to injuries and rheumatic.

Artificial Respiration : This is not so important in case of animals as in the case of men. Yet cases of drowning may occur. Then again, cessation of

respiration may occur under general anæsthesia or due to choking through smoke in cases of fire.

Treatment : Remove all restraints. Open the mouth and pull the tongue out. Place the neck on a higher level than the throat so that accumulated fluids may drain out.

Compress the elastic posterior ribs by alternately leaning with the whole of the body resting on the hands placed over the ribs ; then release the pressure every 4 or 5 seconds. For heavy animal the requisite pressure may be put by a man sitting on the ribs and rising off to relieve pressure alternately.

The foot may be gently but firmly pressed by an attendant against the stomach of the animal once every two seconds and then taken off. It is advisable to extend the fore limbs as far forward as possible by pulling with a rope. After a few minutes of treatment the animal should be turned on another side. The attempts at resuscitation should continue till the animal is found to be quite dead.

Asphyxia is stoppage of breathing. It applies to the condition brought about by the non-oxygenation of blood. Occasionally pressure from fastening rope going tightly round the neck may cause asphyxia, if the noose is such that it tightens on pulling. The more the animal wants to force itself away from the fastening the more tight becomes the grip of the noose, resulting in throttling.

Apart from the endeavours of the animal to escape from the cause which should attract attention, the observable symptoms are a quickening of the

respiration which soon changes to gasping. Then there is general convulsion. After that the heart beat becomes imperceptible and death takes place.

The system in its efforts to correct the deficiency of oxygen due to stoppage of inhalation causes the blood pressure to rise. High blood pressure causes engorgement on the right side of the heart which fails to expel its contents fully with every beat and becomes dilated. With increasing pressure the muscles fail to operate and the heart ceases to work. If a large vein is cut at this stage, there is some relief.

For treatment the pressure from the throat is to be removed and the animal is to be placed in the open. If the breathing is shallow, artificial respiration has to be begun. Inhalation of ammonia may do some good. If the veins of the neck are prominent the jugular vein may be opened to let out some blood by which the pulse may become stronger.

Aspiration : Aspiration is the withdrawal of fluid from the natural cavities of the body. It may be performed for curative purpose or for diagnosis. For curative purpose large quantities of fluid may be removed with the help of trocar canula as in ascites and for diagnostic purpose, only a small quantity may be withdrawn with a hypodermic syringe.

Astringents : Astringents are drugs that diminish discharges and bleeding, e.g., Alum, Copper sulphate, Potash permanganate, Myrobalans.

Atrophy : The decrease in working capacity of any tissue or a part of an organ is called **Atrophy** while the opposite of it, the increase in the size of

the part, is called **hypertrophy**. Atrophy may result from want of nutrition or from the sluggishness of the flow of blood into that part.

Bandages : Bandages are used for protection of wounds. Bandaging is more difficult with the animals than in the cases of human beings.

Ordinary roller bandages may be used for bandaging wounds on the fore legs. But anywhere up, this pattern of bandaging does not serve the purpose. Many tailed bandages have to be used.

Pieces of light cloth cut to size are left with tails and pleated fabric in the form of tapes are secured to these tails so that they may be tied with the opposite tails after encirclement.

Belladona : Use Datura leaves paste in its place.

Bites : Bites should be regarded as infected wounds. A prominent example is *dog bite*. The result of dog bite is infection with rabies which causes death. If the bite be from an apparently healthy dog it may ultimately prove to be rabid. It is, therefore, advisable in all cases of dog bites to get treated for rabies. Snake bites are not uncommon. There are venomous snakes and also non-poisonous snakes. In any case when the snake is not known or if it is not recognised as a non-poisonous one, the bitten animal should be treated for snake venom poisoning. As a first aid a ligature should be put up the bitten part and then another and the place of bite incised and blood allowed to flow out. The incised place is next filled with potash permanganate crystals and bandaged. The

ligatures are to be gradually loosened on seeing the condition of the animal. If a poisonous snake had bitten an animal some time previously, then perhaps there is little to be done. In case of valuable animals anti-venom treatment should be taken up where serum is available. The human dose is to be multiplied, according to the size of the animal.

Bleeding : Hæmorrhage : Bleeding occurs when blood escapes from vessels which naturally hold it. It may be external when blood escapes to the outside or it may be internal when bleeding occurs in one or other of the organs, in which case blood is poured into body cavities. Blood may come out from arteries or from veins or from capillaries. Serious danger is apprehended when an artery is cut. Bleeding from veins may be easily stopped by the application of some pressure. Capillary bleeding is of slight consequence because it soon stops by clotting. Bleeding from stomach is called hæmatemesis ; from lungs ; hæmoptysis ; blood with urine is known as hæmaturia.

When an artery is cut it shrinks and gets within the tissue. If the artery is of small calibre, the shrinking and clotting may stop bleeding naturally. Even when there is a gaping wound, the gap gets filled wiih clotted blood which is soft at first, but which gradually hardens preventing further flow of blood from artery. When, however, a large artery is cut, the bleeding may be so severe that in a few minutes blood may be drained out causing severe

anæmia and consequent death. When serious bleeding occurs the animal has to be put under restraint, then pressure is to be applied, after which styptics or suture and bandages may be applied as the occasion requires.

The animal has to be quieted by restraint. The animal may be caught by the horns and by a rope round the neck and the hind legs hobbled, so that the wounded area may be easily and safely accessible. It should be remembered that the more an animal is allowed to struggle the greater will be the bleeding and greater will be the difficulty in stopping it. The restraint, therefore, should be such as not to permit the animal to struggle.

If the wound is severe and there is great pain on account of the injury and when it becomes impossible to get at the place of injury on account of the struggle, it is advisable to produce general anaesthesia in order to deal with the bleeding and the injury.

Pressure applied by means of a ligature is the first step to be taken. The point of bleeding has to be determined in a cut wound. For this purpose cotton wool or a clean piece of rug may be soaked in salt solution and pressed into the wound. By one or two operations the wound may become clean and freed from dirt, and the clot and the artery discovered. A piece of linen may be put and pressed on when the bleeding may stop by the pressure applied. A soft rope may be passed round the limb and then twisted soas to apply pressure on the artery to stop bleeding.

This is the tourniquet. A piece of stick may be used for producing the torque. When the end of the artery is discovered it can be caught in the grip of an artery forcep and the flow of blood may be stopped by pulling out the artery and tying the end of it with a piece of sterile silk or cotton thread.

Sometimes in less serious cases bleeding may be stopped by the use of substances called styptics.

(1) Application of **cold** or **hot** water will stop bleeding. **Tepid** water *induces* bleeding. Hot, therefore, must be bearably, very definitely hot or it must be cold. Ice is better than either cold or hot water.

(2) **Cautery** or burning with say, a red hot rod of iron may stop bleeding. This is used when the bleeding is from an unapproachable part in which the bleeding artery or vein is embedded in horny or bony surrounding, as in the case of a broken horn core bleeding from its root.

Chemical substances for stopping bleeding are :

(a) A strong solution of common salt in water.

(b) Alum in 10 or 20 per cent solution or as a dry dusting powder.

(c) Copper sulphate.

(d) Catechu.

(3) **Packing** : When the wound is deep and ragged and the bleeding point cannot be located and there is no sign of stoppage by clotting, the contrivance of packing is applied. The wound is packed with linen, made sterile by boiling and made into small balls and pressed into the cavity one after another and the skin

from either side pulled over and stitched by one or two sutures.

Bleeding from the vagina or uterus after parturition and from the effect of forced expulsion of placenta may be of so profuse as to prove fatal. The patient has to be quieted. The part should be washed with an antiseptic. A clean sheet should be boiled in salt water and allowed to cool down aseptically and then put inside on the oozing surface. After stoppage of bleeding the piece of sheet should be slowly withdrawn after 8 or 10 hours without disturbing the clots.

Blood Defibrinated: Blood as flowing in the system consists of substances which may be separated one by one from it. When blood is shed it coagulates in 3 to 4 minutes. On resting, the shed blood becomes a jelly-like mass. After a time a fluid accumulates at the bottom. This is called blood **serum**. What remains as clot is a mixture of the **corpuscles** of blood (erythrocytes) and fibrin. When blood is whipped by a stick, shreds collect on it. This is called **fibrin**.

Again when blood is allowed to cool slowly after being shed the erythrocytes subside and a clear fluid remains above which is called **plasma**.

Blood consists of Erythrocytes or corpuscles and plasma. And plasma consists of fibrin and serum. When fibrin is separated by whipping what remains behind of plasma is serum.

Defibrinated blood is blood from which fibrin has been separated leaving serum and the corpuscles.

Breathlessness : When breathlessness occurs one feels as if suffocated. It is due to the insufficient oxygenation of blood. When there is anæmia, sufficient blood cannot be oxygenated and there is breathlessness or difficulty of breathing. The diseased condition of lungs by failing to fully oxygenate blood gives rise to difficult breathing, such as bronchitis, pneumonia, tuberculosis of the lungs. Again, incompetency of the heart is also a cause of breathlessness. When the heart fails to pump out the requisite quantity of blood, whatever be the cause, there is insufficiency of oxygenation and consequent breathlessness.

Burns and Scalds : Cattle may occasionally have burning injury. In very extreme burns such as from the burning shed, nothing can be done. When burning is less severe and in small patches or only superficial, remedies for alleviating the pain and for speeding up healing are applicable. For slight burns the use of carron oil is the best. It consists of an emulsion of an oil like, tįl, linseed or cocoanut and lime water in equal parts. Lime water is obtained by shaking lime with water allowing to settle. The clean liquid at the top which had dissolved some lime is called lime water. This substance on being shaken with an oil makes an emulsion suitable for application on burns for its soothing and healing effect.

Alternatively gauze or cotton soaked in picric acid may be used. Picric acid removes the burning pain and works as an antiseptic dressing material.

A saturated solution of magnesium sulphate may also be used with the same object.

Burns are caused by dry heat and scalds are caused by moist heat such as by boiling water. Trifling burns and scalds need little attention beyond antiseptic dressing. But when burns and scalds are on an extensive scale, they become very grave sources of danger. Burns and scalds destroy the skin which is a excretory organ such as the lung is. When the skin fails to function, there is accumulation of toxic substances in the body. These affect the system and may cause death. This happens even when the burning or scalding is not deep and is superficial. The effect will be disastrous if a large surface is involved, particularly the surfaces over the visceral organs.

Treatment: The first treatment should be for shock in case of extensive injury. It is to inject morphia in appropriate dose. Next the surface should be cleaned with antiseptic but non-irritating lotion. Picric acid in saturated solution is one of the very best for application as first aid. It sooths the pain of burning. It is an antiseptic and helps healing. It is to be followed by the application of Tannic acid solution in water to be freshly made in 2½ to 5 per cent strength.

It should be noted that exclusion of air from burnt surface minimises suffering and helps healing.

Cachexia: It is the enfeebled condition of any organ or system produced by any serious disease.

Carcinomata and sarcomata: These are tumours usually classified as cancers or malignant tumours. Surgical aid is necessary in dealing with these diseases.

Caries: It is the decay of bones or teeth or a cartilage. It is usually applied to denote decay of teeth. In this disease the enamel of the teeth wears away or some holes are formed in them. In early stages the hole may be filled with tooth cement as in human dentistry. In advanced cases the tooth has to be extracted under local anaesthetics.

Carminatives: Carminatives are remedies that help digestion and expel flatus, e.g., Asafœtida, Camphor, Menthol, Papaya, Soda Bicarb, Thymol.

Caseation: It is the formation of a cheese-like substance in tissues on absorption of pus. It may proceed on to become calcified and hardened.

Catarrh: It is irritatlon of the mucous membrane. It affects the air passages of nose larynx and trachea and the bronchi. Catarrhal inflammation may be present in any part of the mucous membrane of the organs. Intestinal, and stomachic catarrh; catarrh of the genital organs, of the uterus, vagina or urethra are common. In catarrh the mucus gets irritated and there is a flow of secretion from the organs concerned.

Cathartics: Cathartics are purgatives, e.g; Castor oil, Mag sulph, Myrobalan, calomel.

Catheters: These are narrow tubes for passing into the urinary tract for facilitating the discharge of urine. They are made of metal and also of elastic material. Rubber catheters of different sizes are most useful. In males, the urinary passage through the penis of the ox is not a straight one but tortuous. It is a difficult job to pass a catheter through the male

genital organ of the ox. The metal catheter is of no use there.

Cauda Equina : It is the termination of the spinal cord in the sacral and coccygeal regions where it splits up into many nerves, like a horses' tail, hence the name.

Cercaria : An intermediate stage in the life cycle of some of strongyles or small round worms. **(1410)**

Cholagogues : Cholagogues are substances that act on the liver and increase the secretion of bile. The common cholagogues that have been included in the list of medicines are :

Sodium salicylate ; Oil of turpentine ; Calomel ; Magnesium sulphate Aloes.

Chyle : Name given to the partly digested food when it passes down the intestine.

Chyme : Name of the partly digested food passing from the stomach to the first part of the small intestines.

Cicatrix : It is the scar that is left on healing a wound.

Cirrhosis : It is a diseased condition of some of the internal organs such as the lung or the liver in which the essential cellular elements are replaced by fibrous tissue. The word in origin means yellow colouration, because of the yellow colour that comes on liver in the cirrhosis of liver. Fibrosis is another name for cirrhosis. It hardens the organ concerned and may result in its shrinkage.

Collapse : Collapse is a condition in extremely lowered vitality due the system being in a very weak

state. The nervous system is affected, blood pressure falls, action of heart is enfeebled and respiration is slowed down. Death may be due from heart faliure or respiratory failure.

It is caused as the after-effect of severe diseases or in healthy animals as a result of accidents or feats of violent exertion.

In collapse, ensuing from debilitating diseases, the animal lies prostrated, breathing becomes shallow and pulse almost imperceptible. In collapse from violence there may be rapid tumultuous heart action, paleness, sweating, the body being bathed in perspiration. The animal lies almost lifeless and takes no interest in its surroundings.

Attempts should be made to give the animal comfort without disturbing it. If the animal recovers the first sign that appears is thirst and a desire to drink.

Colitis : It is the inflammation of the colon or the first part of the large intestine.

Coma : Coma is profound unconsciousness in which the subject loses all reflex movement.

Compress : Fomentation : When a pad of cotton or linen or gauze is wrung out of water and applied to the affected part it is called a compress. When cold water is used it is a cold compress while application after dipping in hot water is hot compress. Cold compress should be renewed when it begins to be warm and hot compress when it begins to be cold. Hot compress is also known as fomentation. After applying several changes of hot compress the usual procedure is to

keep the compress at site and have it covered by a material impervious to water or moisture and then bandaged. In this way the compress remains at the body temperature and continues to act to the desired end. The object of putting in an impervious sheet is to prevent escape of moisture and evaporation which cools the surface. *Oil silk* is used but is an expensive material. *Plantain* leaves serve the same purpose and is inexpensive. *Oil paper* may be used and can be made by brushing paper with linseed oil and allowing it to dry in air. In this way paper becomes tough and impervious to water.

Congestion : Congestion is the accumulation of blood.

Constipation : The holding of faeces in the system for more than normal time is known as constipation. The abnormality is observable in various ways. Normally defæcation occurs in cattle with almost no effort and it does not much interfere with its movement or work or eating.

Human beings and cats and dogs have to assume particular position and cease other activities when defaecation occurs. Constipation is more a disease of these last named than of the ox or horse. Constipation does however occur in cattle. It may be due to some diseased condition of either the liver or the intestines or it may be due to the ingestion of too dry a food or use of less than necessary drinking water. The atony of the bowels may also cause constipation.

Symptoms : The motions are smaller in quantity and they occur at larger intervals. When the

condition aggravates, there may be pain straining and distress. Breath may become foul and accelerated breathing may show signs of absorption of toxins.

Treatment : Bowels have to be moved. This may be done by giving 1 lb. or 20 ounces of magnesium sulphate in plenty of water. This has to be followed by green succulent feed and plenty of water to drink.

In more obstinate cases aloes extract ½ to 1½ ounce dose is indicated. Castor oil is also an efficient aperient. The administration of the drugs may be assisted by the administration of enema of warm water. Emulsion of castor oil may be used for enema, which makes evacuation easier.

Convalescence : It is the period after an illness in which the symptoms of the disease have ceased but the body is still in a weakened condition and unable to take up normal work.

Convulsions : Violent contractions and relaxations of muscles in alternation, accompanied by unconsciousness and aimless movement of the limbs, constitute convulsions. They may be due to various causes some of which are colic, meningitis, hysteria, milk fever, tetanus, poisoning, parasites in the delicate organs or balled parasites, indigestion with absorption of toxins, tetany etc.

Treatment : Cause should be determined. Sedatives may be useful in some cases, but nothing should be given by the mouth. Cold application on the head and warm on the extremities. Morphine may be given in cases of extreme distress.

Corrosive Sublimate: Mercuric chloride and Mercury perchloride are synonyms. It is a powerful antiseptic and disinfectant. A lotion of 1 in 2000 strength is quite enough for use as a disinfectant. It is however a very corrosive poison, and should be therefore kept away specially secured. It should not be mistaken for mercurous chloride or calomel.

Counter irritants: Counter irritants are drugs that create irritation when applied and used for the purpose of annulling the effects of an already existing irritation e.g., Menthol, Oil turpentine, Acid Salicylic, Carbolic lotion.

Cyanosis: Cyanosis is a condition in which the lips become blue which may extend to the tongue and the membranes of the eyes. It may be due to weak or over worked heart and to insufficient oxygenation of blood. Application of warmth in the region of the heart and ensuring of quietness are some of the requisites. Injection of strychnine to stimulate the respiratory centre may be useful. In severe cases any convenient superficial vein may be opened to relieve blood pressure by letting out blood.

Cysts: Cysts (root meaning bladder) are hollow tumours containing fluid or caseous substance. Sometimes they may be of the nature of a tumour. When eggs of worms are ingested by animals they may develop in the form of cysts in various parts of the body cavity in which the larva remain in the encysted condition waiting development in the stomach of some other animal which may ingest the raw or nndestroyed cyst along with flesh.

Cysts develop in the ovaries of cows. They may occur within tumours in connection with glands.

Datura : It is indentical in its action with belladona which has the following medicinal properties :—

Anodyne, antispasmodic and urinary sedative. It checks secretions of milk, sweat and saliva. It is of the utmost value in relieving cardiac pain and distress, palpitation and aortic regurgitation. In large doses it causes dilatation of the pupils and dryness of the mouth and throat.

Death, Causes of sudden : Sudden deaths occur in cases of anthrax or black quarter. Occasionally a healthy animal is found dead. The first suspicion is naturally snake bite. But it is rarely so. Anthrax often gives its first signal of presence by sudden death of a healthy animal. Young calves may suddenly die on developing black quarter. Then proceed with dis-infection and segregation as sketched under those diseases.

Sun stroke is another cause of sudden death. Similarly heart failure may cause sudden death but in these cases the cause is not difficult of determination.

Tympanites may cause death in a few minutes, observed or unobserved. The great swelling of the abdomen gives indication of the cause of death.

Demulcents : Demulcents are soothing substances for mucous surfaces of the alimentary tract. They afford both relief and protection to inflamed and corroded surface and may be applied externally on the skin also.

Gum, starch and linseed mucilages are demulcents so also isafgul. Glycerine, borax and glycerine, sodium

carbonate, bismuth carbonate are also useful as demulcents for injured surfaces.

Deodorants : Deodorants are substances which destroy, by oxidation, the offending odourous material or which by their strong odour mask the bad odours. The oxidising ones are really useful. Potass Permanganate, charcoal, dry earth, carbolic acid, turpentine, eucalyptus and bleaching powder are some in common use. They are disinfectants also and often the terms **deodorants, disinfectants** and **antiseptics** carry the same meaning.

Detergents : Substances which clean the surface of skin are detergents such as soap, alcohol, alkalies, borax etc.

Diaphoretics : Diaphoretics are substances or appliances that produce perspiration. In fevers and inflammations the action of the skin is disturbed and there is more retention of heat which would otherwise have dissipated through perspiration. One method of inducing perspiration is to apply hot baths. But this is not practicable in animals—specially in the larger ones. Some drugs induce perspiration, such as acetate of ammonia, opium, salts of antimony, but their use for this purpose in animals is not recommended on account of the risks involved.

Diarrhœa : Diarrhœa is indicated by the looseness of bowels. Diarrhœa is the opposite of constipation. In diarrhœa food materials pass out of the disgestive tract before time and before the digestive process is completed. It shows an abnormal condition of the digestive organs and may prove serious if

continued for some time. Some specific diseases, such as coccidiosis, John's disease and white scour are also forms of diarrhœa and they require special treatment.

Diarrhœa is really a symptom of some derangement, and mere stopping of stools is no remedy or worse than a remedy. The causes have to be ascertained and the remedy applied. Ordinary diarrhœa is a form of gastric catarrh when much the same things happen as in nasal or laryngeal or other catarrhs. The mucous membrane of the stomach and intestines are inflamed and they cannot perform their normal function ; as a result slimy and diarrhœic stools are passed out. Gastric catarrh has been separately dealt with.

Treatment : When simple diarrhœa occurs without much specific cause, the routine practice should be to cleanse the intestines of the offending and irritating materials by expelling them through the action of some gentle purgative. Castor oil in emulsion form is one of the most useful remedies. This removes the cause of irritation. After a few hours it should be followed by a sedative such as a mild dose of opium in milk or gruel, and feeding should be stopped for 12 hours or so. Restriction of diet is very necessary. Gruel may be continued for a day or more till stools form. In cases of distressing fluid stools which the above fails to control, astringents like catechu should be given or the dosage of opium should be increased. Intestinal antiseptics, such as sodium salicylate or thymol should be given when it is suspected that fermentative processes are going on. If there is a suspicion of

acidity, lime water should be the first thing to be given after a dose of castor oil emulsion. Acidity may be guessed from the sour smell of the stools and tested with litmus paper. In older animals soda bicarb and chalk powder may be given for diarrhœa combined with acidic stools.

Dip, cattle : The dips are so constructed that the cattle are made to plunge, the dip commencing abruptly. Then they swim to the opposite end where they climb the incline. The dip is filled with the desired solution. The dipping solution may be either of sulphur or arsenic and sulphur. When arsenic dips are used, arsenic is dissolved by boiling in caustic soda and then diluted with water and made up to the required depth in the dip. The water in the dip should contain. 0·12 to 0·25 per cent of arsenic in solution.

The ticks should be found dead after a swim through the dip. For details about making dipping solutions the local veterinary officer should be consulted. For plan and sections of the cattle dip see **Para 959, Vol. I.**

Dishorning : Horns are more or less ornaments in the domesticated condition of the cattle. The defence and offence purposes of the horn are little needed when the cattle are under the protection of man. Horns, however, are a source of danger to the animals when a strong animal attempts to punish another, or the attendant. Dishorning can be painlessly done in the calves, and if thought necessary may be carried out as under :

Calves from 4 to 8 days old should be taken for dishorning. The bud of the horn is wetted and is rubbed with a stick of caustic potash. The operation can be repeated several times on the same day or it may be done once every other day for a week. A scab will form by the solution of the horny matter by the caustic treatment. The scab will dry and fall off with the cells which would have produced the horn. This process is painless to the calf.

Horns may be removed by sawing at the roots. This causes great pain and is a barbarous method. When dishorning of cattle over one month old is to be done, it should be carried out after the administration of a general anaesthetic, such as chloral hydrate. The bleeding may be stopped by passing a hot iron over the matrix or by tying a figure of eight tourniquet round the base of the horns.

Diuretics : Diuretics are drugs that induce the secretion of urine, e.g., Alkalies, Calomel, Oil Turpentine, Sodium Salts, Punarnava.

Docking : It is the operation of cutting of the tail. It is performed on horses and dogs under local anaesthetics. Cows are not docked.

Dosage : The following is a guide for prescribing medicines for cattle of different ages when the adult dose is known :

2 years and over	...	1 part of adult dose
1 to 2 years	...	½ ,,
½ to 1 year	...	¼ ,,
3 to 6 months	...	⅛th ,,
1 to 3 months	...	1/16th ,,

The dose for an adult ox is generally 16 times the dose for adult human beings. For example, if a human dose for magnesium sulphate is one ounce for inducing purgation, the dose for a cow would be on that basis, 16 ounces or a pound. But this is not always so. Castor oil should be given 20 ounces to have the same effect as is given by one ounce in human beings.

The dose for calves from one to three months being one sixteenth of the adult, comes to be equivalent to the human dosage.

Drowning : Cases of drowning in cattle do not occur in the same way as with human beings, for cattle can naturally float in water with their nose above the water level and they can swim naturally as they can walk. Drowning occurs when they are fatigued or loaded down or are splashed about by waves in gales. It occasionally happens that the shore being of very soft clay, the legs go down and the animal cannot naturally get out of the water. They may die in the attempt, out of exhaustion, unless helped out.

When an animal is drowned the process of resuscitation should be attempted as in the case of men. In larger animals the hind quarters should be elevated, small animals should be lifted up by the hind legs so that the swallowed water may be emptied out. The mouth and the nostrils should be cleaned of mud and dirt. The animal should be rubbed and warmed. The animal should be placed on back and pressure should be applied on the chest by a man sitting on it, and then the pressure should be relieved by the man lifting himself off the chest. This

alternate pressure and relaxation of chest makes the chest to be emptied of water, and then filled with air, performing artificial respiration. The process should be patiently tried for a long time before giving up the animal as dead.

The cattle may remain under water for 3 to 4 minutes without being asphyxiated.

Dyspnoea : Is difficulty of breathing, which may approach suffocation.

Dysuria Is the withholding of urine.

Dusting powders : Dusting powders have one advantage over lotions that they require no bandage. Lotions though more efficient in many cases are difficult to be kept at the site after application in the treatment of wounds and skin diseases, for, they require bandaging and bandages are with difficulty kept on animals. Where, therefore, dusting powders serve the purpose, they are to be preferred to wet application, needing bandaging. For application on wounds as antiseptic protective dressing, the following are useful

(1)	Starch	...	4 parts
	Boric acid	...	4 parts
	Zinc oxide	...	2 parts

If an astringent powder is desired, powdered burnt alum is used in addition.

(2)	Alum	...	1 part
	Starch	...	1 part

with carbolic acid a few drops rubbed in to make one per cent of the mixture.

Eclampsia : It is a toxic condition brought on by various causes. Of eclampsias the one most found is parturient eclampsia. The animal becomes restless, looks dazed and moves uncertainly. Sometimes it faints and has convulsions. This stage may happen before or after delivery in maternity cases. Worms may cause this when the disease is called **tetany**.

The treatment consists in detoxicating by liberal administration of water and alkalies. The causes of toxication should be removed. If it is due to parasites, anthelmintics should by given.

Electuary : It is the preparation of a drug in a soft condition by working up powdered substances with syrup, sugar, treacle or honey. When an animal cannot be given medicine in a liquid form to be drunk or for drenching, then the next method of choice is to give medicament in the form of electuaries. It is like lozenges to be given for sucking. Soft electuary may be painted on the mouth with the help of a flat stick.

Embolism : When a small substance gets into the blood stream and gets stuck up anywhere, it is called an embolus and the disease, embolism. The gravity depends upon the position where the blockade occurs. The most dangerous are the places like the brain and the veins in the heart muscle. In the brain it may cause localised softening and consequent paralysis of some part of the body or it may cause death. If the embolus is of large size so as to be able to block an artery it is then called a **thrombus**. Large quantities of air may behave as an embolus in the heart and

cause damage. Blood clots in the blood streams are a fruitful source of embolism or thrombosis.

Embrocations : Are oily fluids used for massaging, containing some counter irritants.

Emetics : Emetics are drugs which promote vomiting. Dogs, cats and pigs vomit with ease. The horse sometimes throws out ingested matter not through the mouth but through the nostrils and indicates a diseased state or injury of a serious nature.

The ox sheep and goat do ruminate which is not vomiting. In these animals vomiting cannot be brought about through the mouth by the effect of drugs. If emetics are given, they cause distress and the drug may pass along the intestinal canal or get absorbed.

Emphysema : Emphysema is the abnormal presence of air in some part of the body. It generally occurs in the lungs. But in a disease like black quarter, gas is evolved and locked up in the muscle tissues which can often be felt from over the skin. Ordinary emphysema is associated with the diseases of the lungs like pneumonia and pleurisy.

Enema : Enema is the injection of fluid into the bowels. It is used to clear the bowels of its contents of accumulated faeces in case of constipation or in cases otherwise requiring the evacuation of the bowels. For this purpose soap water or plain water in large quantities have to be introduced, in full-sized cattle, say, four to eight gallons, to be effective. A continuous flow force pump or a hose and a long funnel are necessary. This is purgative enema.

Vermifuge enema is used for expelling small worms that cause irritation at the anus.

Sedative enema is given to allay the spasms and pain of intestinal colic by introducing large amounts of water containing ½ ounce salt per pint. Alternate application of hot and cold enema is useful in colic. In hot enema, the water should not be too hot but must be comfortably tolerable when the hand is kept dipped in it.

Anæsthetic enema is occasionally given by which the required dose of chloral hydrate is introduced mixed with a gallon of water when the drug cannot for some reason be administered by the mouth.

Enteritis : Inflammation of the intestines as occurring in diarrhœa, dysentery etc.

Enzootic : Enzootic and epizootic are terms corresponding to endemic and epidemic in relation to human diseases. Enzootic or endemic diseases are those infectious diseases that are confined to particular areas. Epizootic or epidemic diseases are those infectious diseases that sweep through areas at particular occasions or periods.

Enzyme : These are complex organic chemical substances which have the property of splitting up food stuff and converting them into absorbable substances. Some food stuffs contain their own enzymes which are liberated under special circumstances. The secretory glands form many of them while others are obtained from the vegetable kingdom.

Epistaxis : Is bleeding from the nose.

Epizootic : See Enzootic.

Eructation : Is belching or sudden escape of gas or of portions of semi-digested food stuff from the stomach to the mouth.

Eruption : Is the appearance on the skin surface of rash, or of pimples, vesicles or reddened areas. Eruptions occur in rinderpest, in foot-and-mouth diseases, in cow pox, in dengue or in urticaria. They have different characters and different significance in different diseases.

Erythema : It is a general term for red eruptions or mere reddening of the skin which becomes engorged with blood.

Escharotics : Are strong caustic substances.

Exanthemata : Diseases characterised by appearance of rash or eruptions.

Expectorants : Expectorants are drugs or agents that promote the secretion of bronchial mucus, e.g., Camphor, Tartar Emetic, Vasaka.

Extravasation : It is the escape of fluid from its containing vessels. Extravasation occurs when there is injury or bruises or when some blood vessels get ruptured. When such a rupture occurs in the brain then the disease is called apoplexy.

Exudation : Is the process of escape of fluid as in sweating. It is also applied to the accumulation of fluid in cavities resulting from this process.

Fainting fits or Syncope : Fainting is due to a sudden failure of the heart, resulting in unconsciousness. It may be caused by want of the requisite supply of blood in the brain, or through weakness of the heart or sudden shock or some severe injury.

The animal should be laid flat with the head at a lower level than the body so that blood may flow. The animal should be cleared of all fastenings. Cold water should be poured over the head.

Fauces : It is the connecting opening, its walls lying between the mouth and the throat.

Ferments : Are bodies which induce chemical change in substances without changing themselves. Yeast is a familiar ferment. It splits sugar solution and converts it into alcohol.

Fibrin : See **blood defibrinated**.

Flatulence Is the collection of gas in the stomach or bowels. Gas in the stomach escapes by the mouth and gas formed in the intestines escapes by the anus.

Fluctuation Is the feeling of the thrill of fluid when pressed at a point and observed on the other side of a swelling. Fluctuation occurs where pus forms in abscesses. In ascites the fluid fluctuates and can be felt.

Functional and Organic Diseases : **Functional** diseases are those that arise from the improper functioning of some organs and systems. In this case, the organs may be alright but their working is inefficient. Just as the heart and its muscles and valves may be structurally normal yet the heart may not function properly and show weakness. The nerve centre in the brain may remain uninjured yet some part of the body may be paralysed. As against this, there may be irregularity or disease due to defect in the organ itself, in which case the disease is called

organic disease. In tuberculosis the lungs fail to function properly because of the injury in them, or in valvular diseases, the heart fails to functlon properly because of the defect in the organ itself. These are organic diseases. If a wider outlook is taken all functional diseases are at the root organic diseases but at the present state of our knowledge the difference is recognised.

Gall Stone : These are formed in the gall-bladder or in the bile duct of the liver, and are concretions round some nucleus.

Ganglion : It is a concentration of nerve cells in the course of nerves. Here the nerve impulses from different sources get accumulated.

Gluteals : Is the name for the buttocks and the structures in that region.

Gestation : It is a synonym for pregnancy.

Hormones : Are substances which upon absorption in the blood stream exert influences on organs other than those in which the secretions were produced. Internal Secretions of glands like adrenal, pituitary, thyroid, ovary, testicles etc., are all hormones and they exercise far-reaching effects upon the system and upon the character of the individual.

Hypnotics : Hypnotics are drugs that induce sleep, e.g., Bromides, Chloral Hydrate, Chota Chandra.

Inflammation : When a tissue is injured it reacts to the injury by inflammation if it is not dead, according to the severity of the injury. This reaction appears in heat, pain, redness, swelling and interference with the functioning of the part.

The first response to injury is in the arteries which dilate and allow more blood to flow and cause heat and redness. After a time white corpuscles of the blood come out into the injured area with a quantity of serous matter which may cause swelling. The white cells carry on repair work. They may succeed in performing repair when resolution of the swelling takes place and the fluid gets absorbed and returns to circulation or otherwise abscess forms, the circulation is interfered with, tissues become destroyed and pus forms. The pus afterwards may get discharged out of the area and the healing process continued.

In the earlier stage of inflammation, the application of cold in the form of cold water or ice is beneficial. In a later stage cold is of no use and heat treatment gives better results. Poultices or hot fomentations which supply both moisture and heat are useful. If an abscess formation is inevitable, fomentation allows it to be formed quickly. When there is great pain, sedatives may be applied. Datura leaves dry powder, made into a paste, with aloes often gives relief to the pain of inflammation.

When the inflammation is in special organs, the condition is disease of that organ and is named accordingly. If it is larynx, it is laryngitis, and if it is lungs it is pneumonia and if it is pericardium it is pericarditis, and so on.

Inhalation : Inhalation is the mode of using a drug in a finely divided and gaseous state so that it may be taken in with the breath or inhaled, bringing the drug in contact with the membranes of the

nose, larynx, trachea, bronchus or all along the respiratoy passage.

Chloroform is applied by way of inhalation to produce relaxation of spasms or unconsciousness. Amyl nitrite is similarly used. These are volatile substances and they need to be presented, soaked in cotton before the nose for inhalation.

Steam inhalation is, however, the most usual form. This is done generally through the atomiser. In this case, steam is made in a vessel and allowed to escape through a jet. At the point of escape is another jet connected with a pipe dipping in a vessel containing the fluid, such as eucalyptus or thymol dissolved in oil or turpentine, to be inhaled. The steam jet produces suction and sucks the fluid through the adjacent jet and the mixed steam and the fluid in the form of a very finely divided spray is used. This is held before the nose and the opened mouth to let the spray pass on to the respiratory passage.

In some cases the drug itself is put in the boiler, and the jet of steam contains the vapour of the drug comes out with it.

Inunction : Drugs may be introduced into the system by rubbing with an oil or fat in which the drug is incorporated. This process is called inunction.

Inoculation : Inoculation is the process of introducing infective materials in the body through wounds or scratches. Diseases may be contracted by accidental inoculation. Inoculation is performed as a productive measure by introducing bacteria in the body through scarification or through injection.

Intussusception : It is a form of obstruction of the intestines in which one part of the intestines slips over another part contiguous to it. The diagnosis is difficult and the treatment is surgical.

Irrigation : Irrigation is the process of washing out a cavity by a fluid. Open wounds may be irrigated by pouring water in the form of a jet over it. Irrigation is helpful in washing out the contents of the colon or the uterus or the bladder. A tube, preferably with a nozzle, is taken. The tube may be of $\frac{1}{2}$ inch or $\frac{3}{4}$ inch diameter rubber hose pipe. At one end it is connected with a large funnel. The funnel is filled with water, plain or medicated as desired. The nozzle is introduced to some length into the interior through the anus or colon or through the vagina for the uterus. A little water is allowed to flow out before introduction to allow the confined air to eacape. Several gallons of fluid may be introduced which may after a time begin to over flow.

Irrigation cannot fully evacuate the contents of the colon. But the limited evacuation that it does, helps the system and the introduction of the cold or tepid water itself acts as a tonic upon the whole of the intestines. For irrigating the uterus, when it must be done, the water is tinted with potash permanganate I : 1000 or 1 : 2000. When there is organic purulent matter, permanganate issues out in a decolorised brown or yellow state. When permanganate begins to come out without a change of colour it shows that septic material has, for the time, been washed out. For irrigating wounds dilute

solution of boric acid is useful. Irrigation in the form of a continual stream of cold water is useful in case of sprain in the tendons and muscles. When the acute stage is passed, irrigation with hot water is useful in causing the flow of blood to the part and stimulating the absorption of accumulated serous matter.

Lathyrism : It is poisoning by lathyrus. If **Khesari** pulse is fed for a considerable time and in large quantities, the animal may show symptoms of poisoning from which paralysis may result. The remedy is to stop feeding Khesari, on getting an indication of the approaching danger.

Lavage : It is the process of washing out the stomach or the intestines. Stomach lavage is done by employing the stomach tube, and for the intestines by enema.

Lugol's solution : It is a solution of iodine in potash iodide having the following composition.

Iodine	...	5
Potass iodide	...	10
Water	...	100

Macules : These are spots on the skin for various causes.

Malignant : Serious disorders are owing to special causes described as malignant. Malignant malaria causes serious injury to the blood much more than ordinary malaria can do. Malignant tumours, malignant œdema, are all serious diseases.

Metastasis : Is the process by which malignant tumours spread to different parts of the body and

create secondary tumours. Such tumours are metastatic tumours.

Mycosis : It means disseases due to the growth of fungi in the body. Ringworm, etc., are examples.

Names of parts of body—scientfic and popular :—

Scientific	*Popular*
Cranium	Fore brain
Occipital region	Poll
Cervical region	Neck
Thoracic region	Withers and back
Lumbar region	Loins
Sacrum region	Croup or quarters
Coccygeal region	Tail
Scapula	Shoulder blade
Humerus	Arm
Radius or Ulna	Fore-arm
Carpus	Knee
Meta carpus	Cannon
1st phalanx	Long pastern
2nd ,,	Short pastern
3rd ,,	Coffin bone
Pelvis	Hunch
Femur	Leg or thigh bone
Tibia and fibula	Second thigh or gaskin bones
Tarsus	Hock
Meta tarsus	Cannon
Pharynx	Throat
Oesophagus	Gullet
Larynx	Voice box

Trachea	Wind pipe
Rumen	Paunch
Reticulum	Honey comb
Omasum	Many plies
Abomasum	True stomach
Coronet	Arc of head.

Necrosis : Is the death of tissues, particularly of fibrous tissues or bones.

Normal Saline : Normal or physiological saline is a solution of common salt in sterile distilled water which is isotonic with the salt solution in the blood, being nearly 0·9 per cent or practically 90 grains to the pint of water.

Normal saline for a time can replace the fluid of blood and, therefore, allow a crisis to be passed over in cases of severe hæmorrhage or loss of blood. It should be given intravenously. For adult oxen upto 1 gallon may be given repeatedly every two hours if necessary. **(1450, 1342)**

Nursing : One should have more faith in nursing rather than in drugs. Drugs can but help nature, so can nursing. Drugs may do injury. Attend to cleanliness, comfort, feeding, starving when necessary.

Obstetrics : Obstetrics is the delivery of the young, and consideration of the abnormalities and diseases pertaining to it.

Opsonins : Opsonins are substances present in the blood serum which enhance the power of white blood corpuscles to devour and destroy bacteria. The opsonic

power of blood can be raised by the injection of vaccines containing dead bacteria.

Os : Opening or mouth.

Os uteri : Opening of the uterus.

Prolapse : Prolapse is the slipping out of some organ or structure. The prolapses of the rectum and of uterus or vagina in parturient animals are sometimes met with.

Prolapse of the rectum follows irritation in the alimentary tract and great straining. The uterus may come out and also the vagina. The best thing to do is to clean the parts and the organ with a 1 : 1000 solution (7 grains to the pound) of potash permanganate. Then a towel is to be soaked in the same solution and wrung out. By taking hold of the organ, it is to be firmly but gently pressed back. The animal often resists the attempts to put it back. When the resistance makes it impossible to put it back, the best thing should be to make it uncomfortable for the animal to strain. This is done by passing a rope round the thoracic region and keep on tightening it. When it is fairly tight a tourniquet may be used and as the animal attempts to strain, more pressure by twist of the tourniquet will prevent it from doing so.

When an organ has come out and veterinary aid is expected, it should be kept covered and moist with a 1 : 2000 lotion of potash permanganate. If an internal organ is left outside in a dry condition, gangrene may follow and eventual destruction, endangering the life of the animal.

For replacement of a prolapsed organ, relaxation may be brought about by dosing the animal with chloral hydrate by which the resistance of the animal will end. This will allow easier manipulation to push the organ back to its place.

Prognosis : Is the forecast of the probable course of a disease.

Pyaemia ; Is alteration in blood by which abscess forms in the various parts of the body due to the presence of pus corpuscles in the blood stream. This disease may be combated by the injection of polyvalent strepto vaccine and also by the oral administration of sulphapyridine or M. B. 693.

Sedatives : Sedatives are drugs that allay irritability or are soothing agents, e.g., Camphor, Castor Oil, Chota Chandra, Datura, Opium, Bromides.

Sinus : The term is applied to narrow, hollow cavities in the body.

Spasm : Is involuntary and painful contraction of muscle.

Sphinctre : Is a circular muscle surrounding the opening from an organ which keeps the opening normally closed and prevents escape of fluid and is relaxed by wilful effort.

Styptics : Styptics are drugs that stop bleeding, e. g., Alum, Turpentine.

Tonics : Tonics are drugs that give tone to the systems, e. g., Arsenic, Iron, Nux Vomica, Arjun, Chinchona.

Tourniquet : It is the appliance for securing temporary stoppage of circulation as in the case of

snake bite or of bleeding from an artery. A rope, cord or handkerchief is passed round the part and tied. In order to make it exert the requisite pressure, a pencil or stick or knife handle is passed under the knot and the stick turned, on account of which the tie grips the part more and more. Care should be taken not to stop the circulation altogether for a long time. For, the entire stoppage of circulation for sometime will cause the death of the part cut off from circulation and set up gangrene.

Truss : It is an appliance particularly in use in hernia in the case of man, for exerting pressure to stop protrusion of the intestines from the natural cavity. It has little use in veterinary practice.

Trocar canula : The trocar is a sharp-pointed stilet with a handle at the opposite end. This fits into a metal tube with a rim, which is the canula. The trocar projects about half an inch beyond the canula. The instrument is used for tapping fluid in ascites and for similar other purposes, such as relieving the pressure of gas in tympanites.

The trocar with its projecting point and the canula slipped over it is passed into the desired cavity e.g., the peritoneum in case of tympanites or ascites. The trocar alone is then withdrawn leaving the canula in the punctured place, This establishes a communication of the inside fluid with the outside, so that gas escapes in tympanites and fluid escapes in ascites. The wound heals by itself after the canula is withdrawn. Antieseptic precaution should be taken when puncturing with the trocar.

Weights & Measures: The weights used in chemical analysis are grams and their fractions or multiples, and the measures are in cubic centimeter, its fractions or multiples. One cubic centimeter (c.c.) of water at 4°C. exactly weighs 1 gram. A centimeter again is a measure of length. A block of water one centimeter in length, breadth and height is a cubic centimeter. The weight of this is one gram. A schedule of equivalent weights and measures is given below :

Measures of Length.

1 inch = 2·5399 centimeters (= 2·54 approx).

1 foot = 30·4794 centimeters (= 30·48 approx).

1 yard = 91·4383 centimeters or 0·914 of a metre

To convert inches into centimeters,
multiply by 2·54.

1 centimeter = 0·3937 inches.

1 metre = 100 centimeters = 1 yard and 3·37 inches.

To convert centimeters into inches, multiply by 0·39.

To convert meters into yards multiply by 1·09.

Measures of Weight.

1 grain = ·0648 grams.
= 64·8 milligrams.

1 dram = 3·9 grams.

1 ounce = 28·35 grams.

1 pound = 453·592 grams. Roughly ½ kilogram.

1 kilogram = 1,000 grams.

To convert ounces (Avoir) into grams
multiply by 28·35.

To convert pounds into grams multiply by 453·6.

To convert pounds into kilograms multiply by 0·454.

1 milligram = 0·0154 grains.
1 gram = 15·43 grains.
= 0·0321 ounces.
1 kilogram = 1,000 grams.
= 2·2046 lbs. (Avoir.).

To convert grams into ounces multiply by 0·0352.
To convert grams into grains multiply by 15·432.
To convert kilograms to pounds multitply by 2·2046 or roughly 2·2 lbs.

Measures of Capacity.

1 fluid dram = 3·544 cubic centimeter (c.c. or mil.).
1 fluid ounce = 28·412 c.c.
1 pint = 567·933 c.c. or 0·568 litres.
1 gallon = 4·54 litres.
1 litre = 1,000 c.c. or mil.
= 35·196 fluid ounces.

To convert ounces into c.c. multiply by 28·412.
To convert pints into c.c. multiply by 568·0.
To convert gallons into litres multiply by 4·54.

1 cubic centimetre = 1 gram distilled water at 4°C.
= 0·061 cubic inches.
= 0·0352 fluid ounces.
= 16·896 minims.

To convert c.c. into ounces multiply by 0·0352.
To convert litres into pints multiply by 1·76.
To convert litres into ounces multiply by 35·196.

1 c.c. = $\frac{1}{1000}$ litres = 1 millilitre (or 1 mil.)
= 1 gram distilled water at 4°C.

1 gallon = 10 lbs. of water occupying 277·274 cubic inches (4·54 litres).

Weights.

1 Dhan = 1 grain of paddy.
4 Dhans = 1 Rati, Gunchi.
6 Ratis = 1/16th tola.
96 Ratis = 1 tola.
4 Kanchas = 1 chatak.
One Sikki = quarter tola.
8 Ratis = 1 musha.
5 Sikkis = 1¼ tola or 1 kancha.
1 Tola = 180 grains.
5 Tolas = 1 chhatak.
2½ Tolas = 1 ounce.
4 Chhataks or 20 tolas = 1 pawah
4 paws, 16 chhatak, 2 lbs. or 80 tolas = 1 seer.
1 Seer = 2·057 pounds.
5 Seers = 1 pasri, 1 dhari.
40 srs. = 1 maund.

Measures of weight of the British Pharmacopœia.

1 grain = grain (i).
437·5 grains = 1 ounce.
16 ounces = 1 pound. (1 lb.)
or 7000 grains = 1 lb.

Measures of capacity of the British Pharmacopœia.

1 Minim = mi.
60 Minims = 1 fl. drachm.
8 Fluid dr. = 1 fl. ounce.
20 Fluid ozs. = 1 pint (o·i).
8 Pints = one gallon.

Apothecaries Weights.

20 grains = 1 scruple.
3 Scruples = 1 dram.
8 Drams = 1 Fl. oz.
12 Ounces = 1 pound (lb.).
20 Fl. oz. = 1 pint.
2 Pints = 1 quart.
24 Fl. oz. = 1 bottle.
160 Fl. oz. = 1 gallon.

Avoirdupois Weight.

16 Dram make 1 ounce.
16 Ounces make 1 Pound.
28 lbs. make 1 Quarter.
4 Quarters make 1 Cwt.
20 Cwts make 1 Ton.
112 Lbs. make 1 Cwt.
2,240 Lbs. make 1 Ton.
1 stone make 14 Pounds.

Table of Weights.

1 milligram	=	...	0·001
10 milligrams	=1 centigram (cg.)		0·01

10 centigrams	=1 decigram (dg.)	0·1
10 decigrams	=1 gram (Gm.)	1·
10 grams	=1 Dekagram (Dg.)	10·
10 Dekagrams	=1 Hectogram (Hg.)	100·
10 Hectograms	=1 Kilogram (Kg.)	1000·

Table of Measures.

1 milliliter (cc.)	=1 cubic centimeter	0·001
10 milliliters (cc.)	=1 centiliter (cl.)	0·01
10 centiliters	=1 deciliter (dl.)	0·1
10 deciliters	=1 Liter (L.)	1·
10 Liters	=1 Dekaliter (DL.)	10·
10 Dekaliters	=1 Hectoliter (HL.)	100·
10 Hectoliters	=1 Kiloliter (KL.)	1000·

Table of Weights and Measures.

1 milligram (mg)	0·001 =	1/64 grain
1 centigram	0 01 =	1/6 grain
1 decigram	0·1 =	1½ grains
1 gram	1· =	15½ (15·432) grains
4 grams	(3·9) =	1 drachm
31 grams	(31·1) =	1 ounce
500 grams	(453·6) =	1 pound (av.)
1 Kilogram	=	2·2 pounds (av.) (2·2946)
1 minim	=	0·61 cc.
16 minims (16·23)	=	1· cc.
1 fluidrachm	=	3·75 cc.
1 fluidounce	=	30· (29·572) cc.
1 pint	=	500· (·4731 L. or 473 cc.)

THE END OF VOL. II.

THE COW IN INDIA

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CLASSIFICATION OF INFECTIOUS AND CONTAGIOUS DISEASES ACCORDING TO THE NATURE AND FAMILY OF THE MICRO-ORGANISM.

(1) Bacterial Diseases.

Family.	Name of Micro-organism.	Nature of diseases.
Coccaceae.	Strepto and staphylo coccus.	Payaemia. Joint ill. Navel ill. Mastitis.
Bacteriaceae.	Pasteurella boviseptica.	Pasteurellosis or H. Septicaemia.
	Bacterium coli. (Escherichia coli)	Navel ill.
	Brucella.	Brucellosis or Bang's disease.
Bacillaceae.	Bacillus anthracis. Clostridium chauvoei. Clostridium tetani.	Anthrax. Black quarter. Tetanus.
Actinomycetaceae.	Actinomyces bovis.	Actinomycosis.
Mycobacteriaceae.	Mycobacterium tuberculosis.	Tuberculosis.
	Mycobacterium paratuberculosis.	Para tuberculosis.
	Fusiformis necrophorus.	Calf diphtheria.

(2) **Protogoal Diseases**

Family.	Protozoa.	Diseases.
Emeria. .	Emeria zurnii. .	Coccidiosis.
Piroplasm or Babesia.	Babesia bigemina. .	Piroplasmosis or Tick Fever.
Trypanosoma.	Trypansoma evansi.	Trypanosomia -sis or Surra.

(3) **Diseases from ultra visible viruses**

Family.	Nature of diseases.
Viruses. .	Rinderpest. Foot-and-mouth disease. Dengue. Cowpox. Contagious Pleuro-pneumonia. Rabies.

ERRATA

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